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# Selecting Land Use For Sand and Gravel Sites



David R. Jensen  
University of Illinois



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# Foreword

This publication is the third research report based upon the Research Program sponsored by the National Sand and Gravel Association at the Department of Landscape Architecture of the University of Illinois. "Simultaneous Excavation and Rehabilitation of Sand and Gravel Sites," by Anthony M. Bauer and "Practical Operating Procedures For Progressive Rehabilitation of Sand and Gravel Sites," by Craig Johnson were the first two published reports; the research for the fourth report is already underway.

The Research Program is sponsored by the Association through its Committee on Public Relations and is supervised by a Research Advisory Committee, the membership of which includes: Wm. G. Carnes, Department of Landscape Architecture, University of Illinois, (Chairman); Cecil G. Cooley, Cooley Gravel Company, Arvada, Colo.; Kenneth L. Schellie, Schellie Associates, Inc., Indianapolis, Ind.; Walter I. Thieme, American Aggregates Corporation, Greenville, Ohio; Louis B. Wetmore, Deputy Commissioner, Department of Development & Planning, Chicago, Ill.; and Cyril I. Malloy, Jr., Association Staff Representative.

This report represents the conclusion of the third year of a four-year research plan. Industry and professional response to the results of this Research Program has been universally favorable.

While the research topics assigned to the first two research reports have been general in scope and the present report more particularized, we believe that they have specific and practical value to all members of the Association and to many professional landscape architects, land use planners, conservationists, and others with a professional interest in the subject matter. This report, together with the Bauer and Johnson reports and "Site Utilization and Rehabilitation Practices for Sand and Gravel Operations," by Kenneth L. Schellie, now provide a substantial library of knowledge on the subject of rehabilitation of sand and gravel sites. In addition to the practical value of these reports, there has been increased value in the promotion of rehabilitation throughout the industry as evidenced by the growing number of producers who are retaining professional landscape architects and planners on a permanent basis.

*Research Advisory Committee*

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# Selecting Land Use for Sand and Gravel Sites

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**Figure 1 — Increasing Populations Demand Wise Use of Our Resources—Both Exploitation & Development**

## *Chapter 1*

# Introduction

## **Background**

Our nation is in a situation where population demands around our urban centers are pressing on adjacent natural resources. This is the plight of sand and gravel deposits, where the use of land for mining is in direct competition with urban expansion. By the year 2000, five-sixths of the 350 million population<sup>1</sup> (a fifty per cent increase over 1965) will be in urban areas. Housing needs will increase proportionately from 1.3 million new units to approximately 1.5 million as it did from 1960 to 1965<sup>2</sup> (Fig. 1).

In the future, the demand for shopping, working, and recreational space will also increase, thereby placing a producer with development potential in a better position to advance the use of mined-out land to a dual-role function by providing land suited for residential or business development after operations cease (Fig. 2).

Utilization of land associated with depleted sites will depend on physical site conditions, expense for site preparation, and what will be acceptable and useful in the immediate environment. Beneficial returns from development can be measured monetarily, in intangible esthetic values, or in the conservation and wise use of three basic assets: (1) the mineral resources, (2) the

land, itself, and (3) the natural qualities of site conditions.

The sand and gravel producer has bigger and better equipment for extracting sand and gravel resources. As equipment potential has been growing and great changes can be made during excavation, so also has the ability increased to shape and grade the site into more usable land forms to satisfy future land use requirements. For instance, bulldozers and scrapers make short work of leveling overburden that once was thought insurmountable. Topsoil and overburden once stockpiled and distantly inaccessible can now be distributed readily with modern push-button three-in-a-line scrapers at nominal cost and time (Fig. 3).

Prospective developers should look both at operation-caused drawbacks and advantages. While in most instances developers do not consider depleted gravel sites as available land, a finely-graded and pleasantly green site would be accepted readily. Where the developer has a choice between land that is rugged and unfinished or an undisturbed or graded site, he really has little choice but to accept the latter. Mainly, his choice is based on whatever foresight or perspective he can command in order to determine the potential use of the unfinished site (Fig. 4).

Beauty has an economic value, while dereliction and





**Figure 2 — The Sand and Gravel Industry Produces Material for This, ..... And This, .....**

ugliness create high economic costs for the producer. It is possible to estimate the economic loss when bad conditions impede or fail to attract development of a depleted pit site. It is difficult, however, to estimate the economic loss attributable to the unfinished site against the known cost of grading for ultimate development. For instance, even where the grading cost involved is higher than returns from crop production, the site will warrant finishing simply because it is a disadvantage to an expanding community and producer as derelict land.

Because the rate of extraction demanded nationally will increase or at least be consistent for the future with the 76.4 per cent increase in production of sand and gravel between 1958 and 1964, the producer should try to make the increasing area of depletion as inoffensive and pleasantly compatible with surrounding conditions as possible. For example, the returns from sale of forest products, while the developer is waiting for demand by a higher use, may never be great compared to the esthetic qualities of the reseeded and forested cover use.

A site located in a wooded area that best suits transitional treatment before final use, therefore, should be forested. Again, a site in an agricultural region may be best suited for cattle forage until adaptation is appropriate for a more intense use such as recreation or residences. The choice of treatment for each site, whether for vegetation or a sanitary fill, will depend on the location of the site, type of excavation, soil conditions, and requirements of the final use.

### **Purpose of This Report**

It is the intention of this report not only to provide knowledge of past and recommended practices, but to suggest new methods of approach for the development of sand and gravel sites. The author hopes that this report will illustrate fundamental considerations for selected potential uses, taking as a primary motive the creation of livable, useful, and rewarding environments.

Generally, the report is intended to do the following:

1. To offer guidelines, which will help both industry and interested readers understand the ultimate development potential of sand and gravel sites.
2. To create an awareness of the major benefits, potential, and problems of developing depleted sites simultaneously with operations.
3. To suggest fresh approaches to industry policy so that future developments will exceed the past quantity and quality of achievement.

### **Previous Research**

In the first research report, "Simultaneous Excavation and Rehabilitation Practices of Sand and Gravel Sites," a general survey of the sand and gravel industry was conducted to identify significant site and operational factors of the total industry, to review land development opportunities, and to provide general guidelines or criteria for a combined pre-planned excavation and development program. The first report was based on the premise that in order to develop fully the potential of a given site and to satisfactorily reduce inherent operational conflicts, planning should occur before operations are begun. Actual sites were used as case studies and the presidents of these companies concurred that either no increase in the cost of operation would result or that any increased costs would be more than offset by resulting increases in land values.

A second study, "Practical Operating Procedures for the Rehabilitation of Sand and Gravel Sites" was directed at the heart of the rehabilitation program — the equipment and operations. The hypothesis was that sand and gravel sites can be most effectively developed for ultimate use by using standard operational procedures to produce the desired end result during the excavation process. The objectives were to illustrate how equipment and related operational patterns can achieve an efficient dual role of excavating sand and gravel and developing the mined area.

This third report is timely because it represents a culmination of the basic development procedures which seem theoretically possible. It is important to make a sharp accounting of future land use to insure orderly, esthetic, and functional use of present and future depleted sites. This summary of the development potential hopefully will be of value and interest to sand and gravel producers and to the professionals concerned with this industry.

### **Objectives**

Sand and gravel operations today are more versatile and useful in terms of development potential. Largely through coordination of master plans for final development and operations, the producer, landscape architect, engineer, planner, and market analyst can produce esthetic and functional land for use.

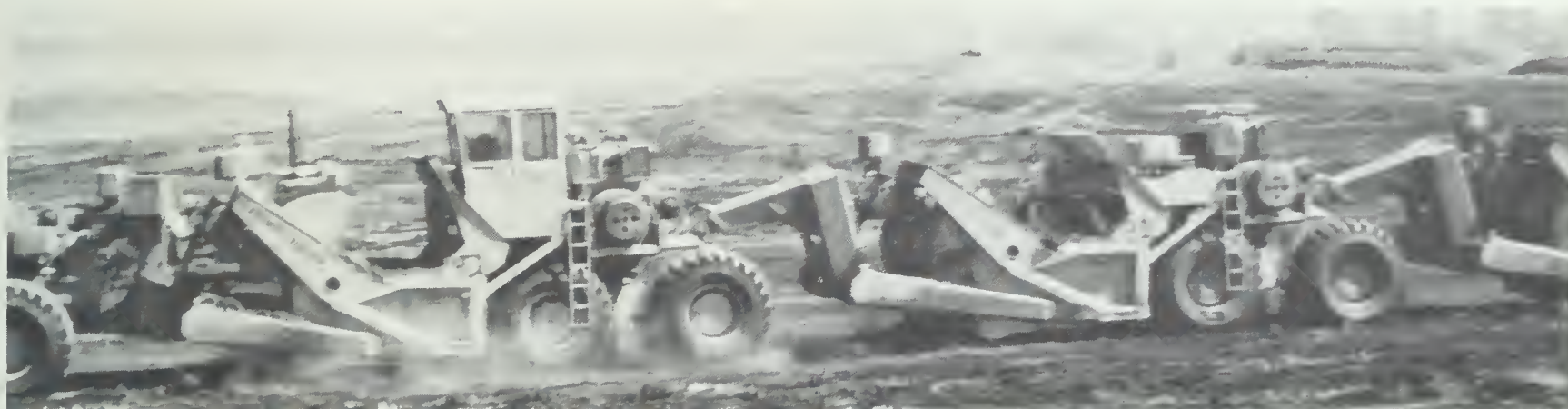
Sand and gravel extraction is generally short-term in relation to other land use types, and the land has immediate potential for reuse after excavations are com-





While Providing Land for This,

And this.



**Figure 3 — Three-In-A-Line Scrapers Provide Economical Distribution of Overburden**

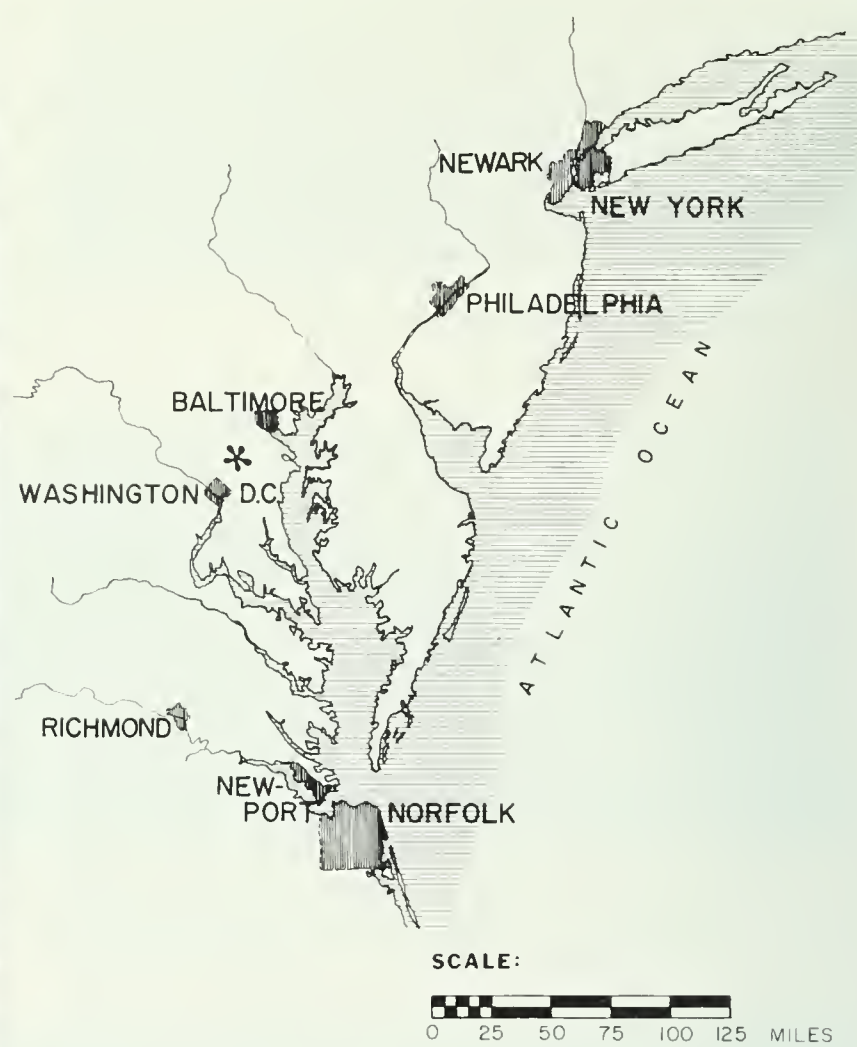
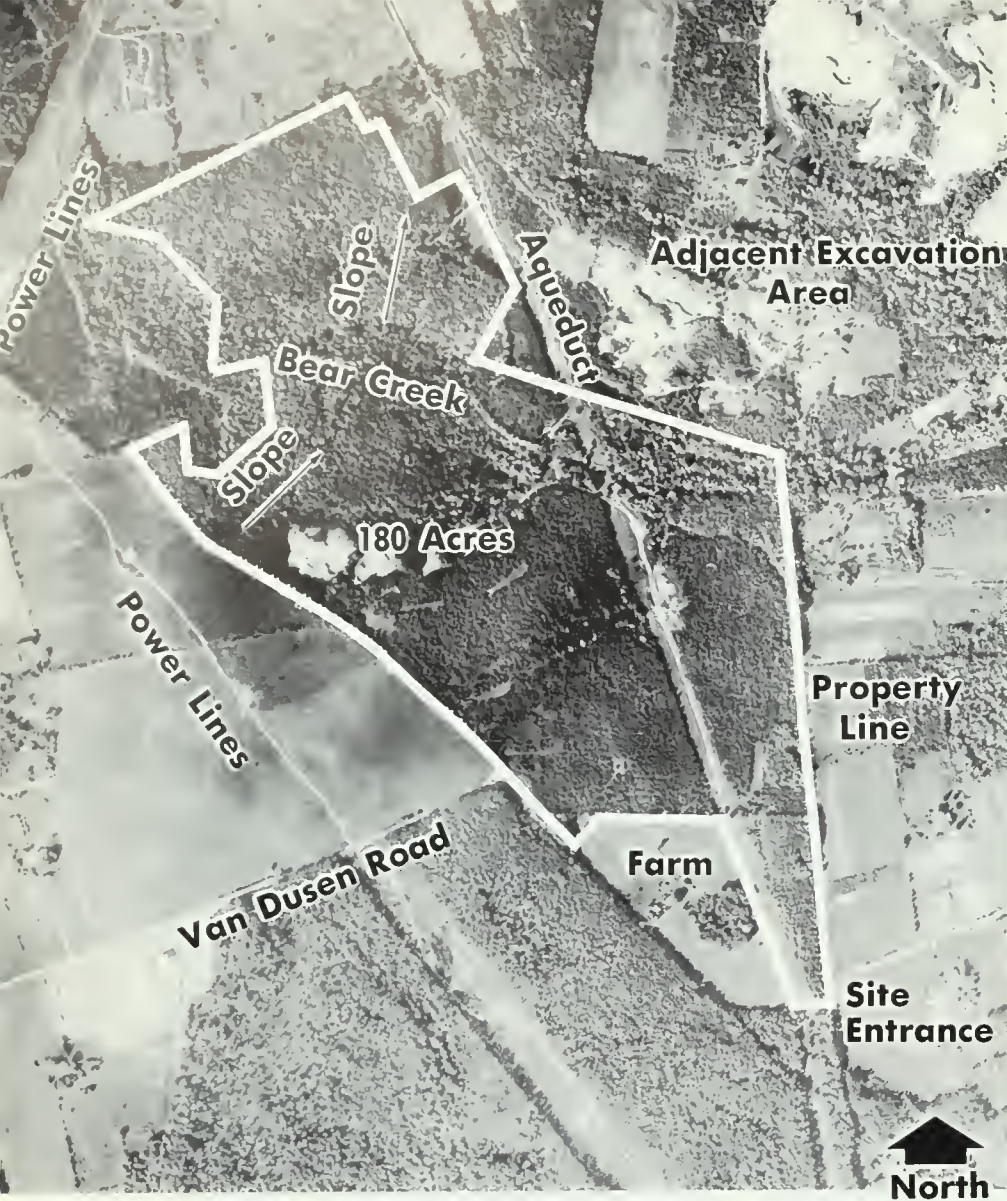


**Figure 4(A) — The Unfinished Site**

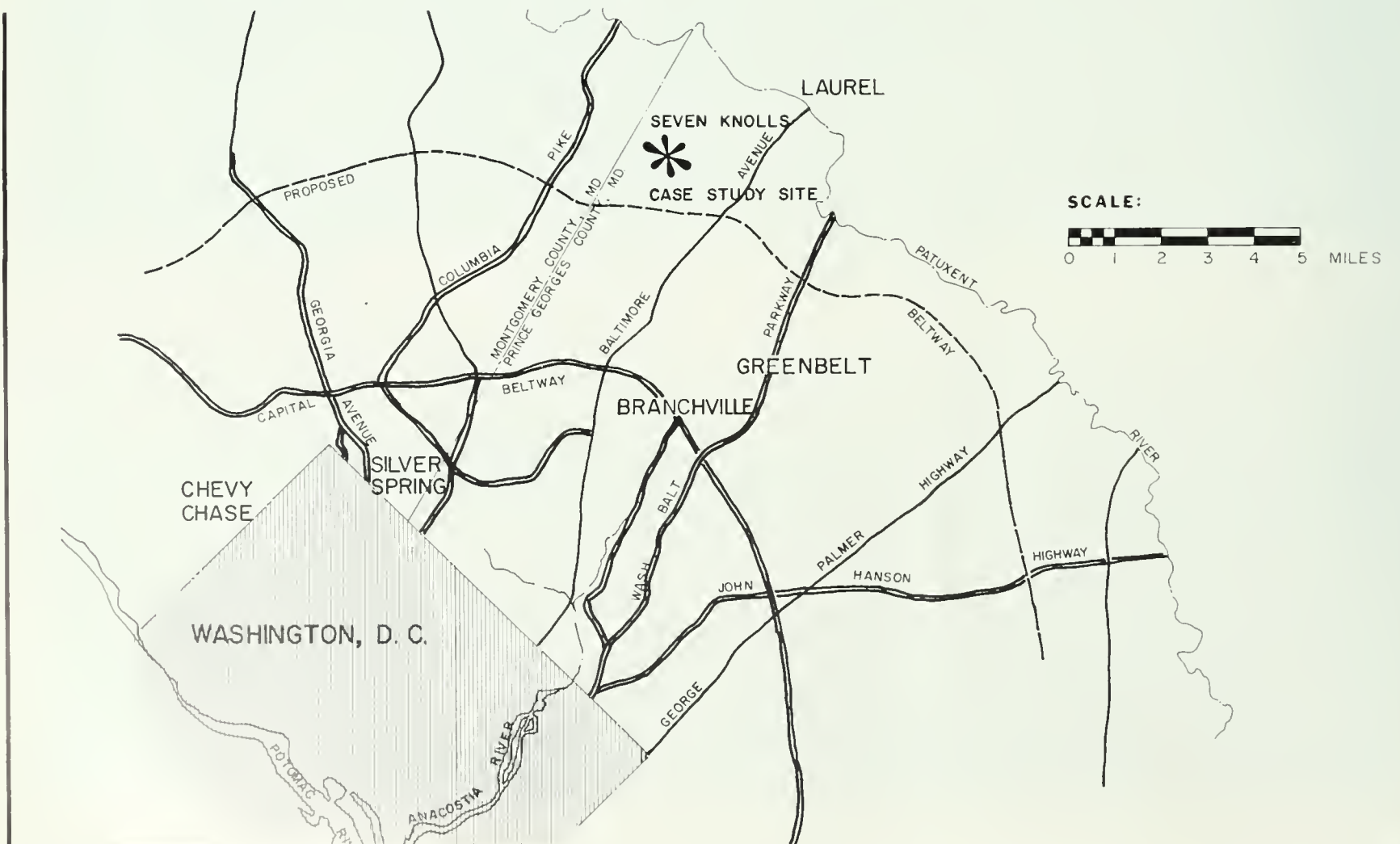


**Figure 4(B) — The Finished Site**





**Figure 5(B) – The Site—Seven Knolls**



**Figure 5(A) – Site Location**







**Figure 5(C) — Seven Knolls Before Excavation—a View North Along the Aqueduct**

pleted. In the path of our expanding cities and urban centers, the depleted sites will eventually be in demand for development. Landscape planning for sand and gravel operations should be oriented, then, toward accomplishing the maximum double use of the land — *permitting excavation* plus providing a final *optimum land use* — through utilization of site features to full potential.

A definite relationship exists between site conditions which the producer can control and the requirements for the ultimate use which sites of various types can best support. Successful simultaneous development requires knowledge of the typical site features and conditions, the operation potential to meet use requirements, and a detailed development master plan to guide excavation activities efficiently.

The objectives of this report are as follows:

1. To identify land use determinants and elaborate on the items which the producer through operations can control.
2. To suggest development techniques for the optimum use of mined land.
3. To summarize land use types which are typical of the land use categories.
4. To illustrate adaptation of typical land use types through use of case studies by identifying development techniques for optimum utilization of a dry pit operation.

Other less essential goals will be to determine what variables the producer should take into consideration when making his land use decision. A focus can then be taken on those variables which relate to the features and forms of a site and to operational choices and methods. In most cases, the producer will have alternatives, especially as to how much money to spend for adaptation to various uses. Attempts will be made also to define resultant forms of normal operations and suggest their utilization.

The following chapters analyze the different nature and forms of pit operations and the general requirements and development plans of selected representative land use types. The aim is to summarize the excavation and illustrate in general terms techniques for the harmonious correlation of operations and planning for adaptation of a selected land use. The actual period of shaping the site for use will not be significant. What is important, though, is the interim land use, mining and the efforts or process used to create the ultimate usable landscape.

## **The Case Study Site**

The 180 acre case study site for this third research report will be used to illustrate the adaptation of land use types to a dry pit operation. This site, owned and operated by the A. H. Smith Company, Branchville, Maryland, is located between the existing city of Laurel, Maryland and the proposed city of Fairland in the midst of farming and woodlands. (Fig. 5). Intense mining began in 1965. When completed, this site will contribute millions of tons of aggregates for construction.

At the time of purchase, this site was not zoned to control mining; presently, it is indicated for 10,000 square feet housing lots and a preliminary proposal for reuse, made by the Maryland National Capital Park and Planning Commission, indicates a Community College.

Deposition of sand and gravel on this site occurred 63 to 135 million years ago and contains few fossil remains though a few petrified tree remnants occur. The deposit which exists on knolls to 50 feet deep contains a 1:1 and 1:5 ratio of gravel to sand. Tests indicate that the silty-clay washings from sand and gravel processing in this region may be used for making bricks.<sup>3</sup> The deposit is overlain with 6 feet of overburden with nearly 3 feet of unmineable material occurring in the deposit which can be used for creating land forms, filling low areas, and blending the basegrade into the surrounding land. Much of the existing surrounding land will be mined, thus eliminating a portion of the cutbanks.

Present development on land mined by the A. H. Smith Company, since beginning operations in the 1920's, includes shopping centers, banks, service stations, a school, single-family and apartment housing, a church, and other facilities contributing to the development of this area.



## **REFERENCES**

- <sup>1</sup> CROSBY, THEO., *Architecture: City Sense*, Studio Vista London, Reinhold Publishing Corporation, New York, p. 33, 1965.
- <sup>2</sup> U. S. DEPARTMENT OF COMMERCE, *Construction Reports: Housing Starts*, February 1966, Bureau of the Census, U. S. Government Printing Office, Washington, D.C., p. 3.
- <sup>3</sup> WITHINGTON, C. F., *A Potential Source of Brick Clay in the Beltsville Area, Prince Georges and Montgomery Counties, Maryland*, Geological Survey Research 1966, Washington, D.C., pp. D203 — D208.





**Figure 5(D) — Seven Knolls Case Study Site During Excavation**



**Figure 5(E) — Seven Knolls During Excavation**



# Land Use Selection and Site Development

*Flexibility of operations, equipment capabilities, and an accumulation of knowledge in development techniques are important factors which can enrich the future potential uses of mined land.*

## SECTION 1 Land Use Selection

### Optimum Land Use

Sand and gravel operators are experienced executives who desire to adapt their land for uses which promise profit returns. In this respect, the operators allocate their land in accordance with the highest and best use, although economic considerations may finally determine disposition of the depleted site. Also important are esthetic and community values, site potential, or some combination of these.

The optimum use for a site depends upon the site conditions after operations, such as slope, location, size of property, and quality of soil. (Fig. 6). Even the most efficient physical adaptation of any particular site is subject to change; for example, it may be affected by zoning ordinances or changes in other public policies. Also, whenever changes in the demand for different types of land use occur, the operator may want to re-examine his proposals for development.

Variations in the anticipated basegrade or ground water level also may demand change in development. Changes in surrounding land use, as for industry, may mean a switch from planned residences.

Accuracy in anticipating demands for the future will vary with the amount of time involved between starting

the excavation and finally implementing the development. Certainly a producer, with professional consultation, anticipating development ten years hence should be able to forecast the ultimate re-use; predicting 30 years ahead is considerably less accurate. In all cases, the extent and accuracy of the survey and analysis of the site and surrounding areas, coupled with projections for the future land use, will determine the accuracy of optimum selection.

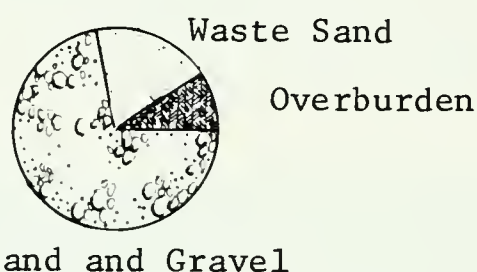
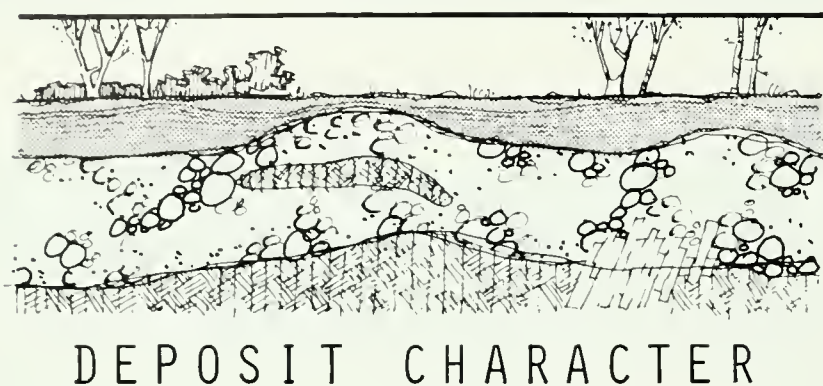
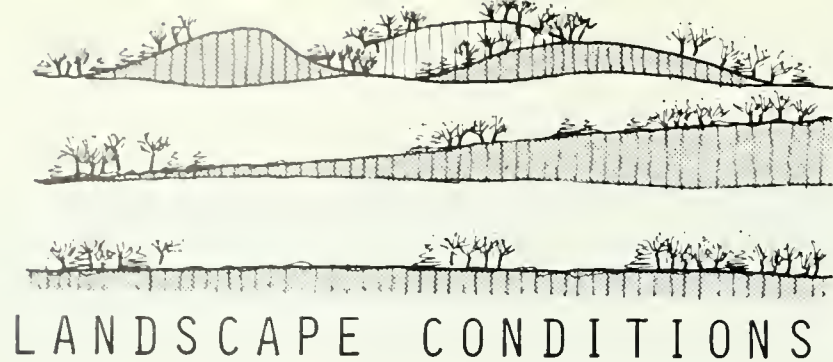
From the start, excavation activities should be undertaken in conjunction with development plans, regardless of how distant the completion date of the excavation. Provisions for temporary re-use of the land at the completion of each excavation stage, as an interim step before final development, will be an important consideration for stabilization and natural site beauty.

Since the producer may be limited in his knowledge of evaluation techniques, it is the purpose of this section to supply information for preliminary evaluation of the basic land use categories and determine physical criteria for site suitability.

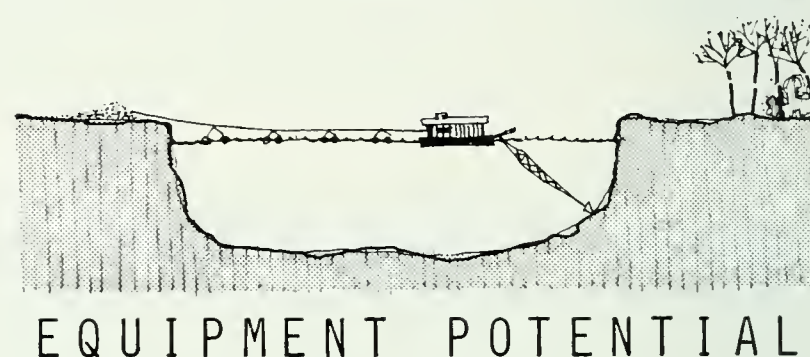
### Optimum Land Use Determinants

Four general factors can affect both the selection and design of a final land use: (1) the *location* of the site with proximity to urban areas, to transportation, surrounding land use, and expandability of the site will influence the final land use; (2) *Landscape conditions*, such as the slopes, soil quality (see Appendix), elevation of the site, drainage (both surface and subsurface), water table, site character, and presence of nuisances or hazards determine whether the site is suitable for agri-





WASTE MATERIAL  
AVAILABILITY



**Figure 6 — Factors Affecting the Final Landscape Conditions**

culture, recreation, residences, industry, or some of the other activities; (3) Similarly, the *scope and cost of site improvements* necessary such as regrading may economically limit some re-use such as industry or residences; (4) *Intensity* of possible re-use (density of housing or intensity potential for recreation) is regulated by the amount of site usable for each purpose.

In the following pages, these four factors will be considered for their effects on the selection of general use categories such as: industrial, commercial, recreational, agricultural, and residential. More detailed requirements for selected sub-types of these categories will be presented in Chapter III.

### Location

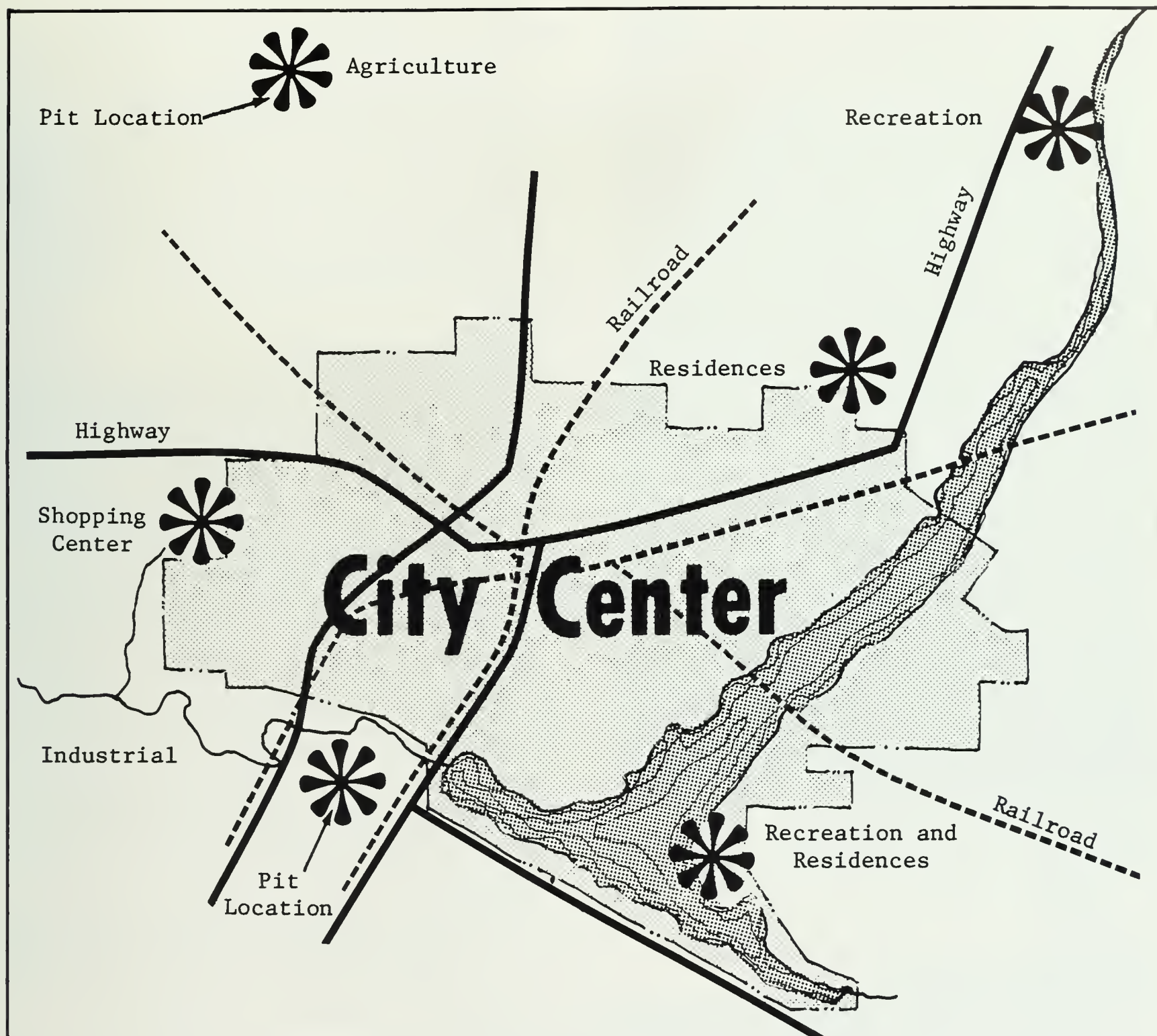
One of the most important determinants of a land use is the site location (Fig. 7). While sites near the periphery of urban growth will be generally developed for intensive use, the more distant location will be conducive to the less intense types such as low-density housing, recreation, and agriculture. A site located in a low-lying area such as a flood zone will have limited

land use capabilities. A location in the path of industrial expansion may be best suited for similar manufacturing and the site adjacent to a major highway may be suited for commercial or public recreation. In all cases sand and gravel sites will attract those uses to the locale that best satisfy development criteria.

Figure 8 is an evaluation of the Seven Knolls case study site in terms of a Community College presently proposed for this site by The Maryland National Capital Park and Planning Commission (Fig. 19, PROPOSED LAND USE). The chart is used here to determine the desirability of this site for a college and to indicate deficiencies in this locale that require correction before final decisions are made for use of this site. This chart demonstrates a method for evaluating other sites. Figures 10 and 12 evaluate this site in terms of physical conditions and perceptual values.

Sites suitable for industry should be within easy commuting distance of residential areas and accessible to major traffic routes connecting housing and market areas. Besides needing utility services, the site must be compatible with surrounding uses in terms of views, prevailing winds, protective belts of planting, open





**Figure 7 — Location as a Land Use Determinant (Theoretical)**

space, noise, and access routes. Sand and gravel sites considering industry should show easy and direct access to trucking routes and major street systems for incoming goods, outgoing deliveries, and working force.

Commercial types of land use depend upon locations adjacent to the flow of major traffic and central to proposed trade areas. In addition to economical construction, which is dependent upon buildable slopes, consideration should be given to space for parks, buildings, buffers, and general amenities within the area and its boundaries.

Residential development and institutional uses such as schools, medical centers, and large churches depend on environments of quality and strong character. Site size requirements vary greatly, but generally require

large areas for development completeness, including accessory parking, outdoor uses, and buildings or community facilities where needed. An optimum site will have good approaches and will not infringe upon or degrade the character of surrounding uses. Access should be generally good, though this category does not strongly depend on major traffic routes for successful operation of facilities.

Unusual land forms and drainage creeks in certain locations may be added amenities for wilderness-type extensive recreation, but may still be unsuitable for level playgrounds and recreation centers. Recreation areas can be well integrated with residential surroundings and large recreation development should be within easy commuting distances of user areas.



DETERMINANT	CRITERIA	EVALU- ATION	EXPLAN- ATION
Location	Would it be conducive to this site or location?	Good	Rural
Proximity to Urban Area	What is the affect of the site's urban, suburban, rural location?	Good	
Demand for Development	Can this region support more of this type use?	Good	
Surrounding Land Use	Is there compatibility or conflict with existing or anticipated uses?	Good	
Access to the Site	Is it easy, restricted, or flexible?	Fair	From secondary Roads
Proximity to Major Thoroughfare or Other Transporting Means	Is the site proximity good; required; important?	Fair	Lack of existing or proposed direct access to Interstate 95
Transportation	Stress to existing? Improvable?	Fair	Through residential areas
Expandability	Are adjacent areas built up, vacant, natural, usable; will it affect use?	Fair	
Proximity to Utilities	Availability; needed?	Good	
Public Relations Benefit	Optimum, mediocre, poor?	Good	
Community Benefit	Needed, contributes, functions?	Good	

**Figure 8 — A Relative Comparison of Seven Knolls as a Site for a Community College**

## Landscape Conditions

Residential, commercial, institutional, and industrial activities generally require similar site conditions (Fig. 9). Such requirements are modest terrain differences like 1 to 15 per cent slope (the highest slope best suited for small buildings), soils sufficiently strong to bear needed buildings but not excessively difficult to excavate, permeable and internally well-drained soils, absence of flood hazards (see Appendix), and other landscape conditions, such as compatible surroundings and freedom from dust and noise, though not at the same degree.

Figure 10 is an evaluation of Seven Knolls in terms of physical conditions for use after operations, and their effect on the final land use (see Fig. 25-29). The intent here is to evaluate conditions which will affect the proposed Community College and perhaps emphasize problems that will need to be corrected.

Within the broad recreational group, natural conditions required determine the possible activities. For intensive activities, such as field games, nearly flat or

gently sloping land is best; extensive activities such as hiking, by contrast, are suited for rugged terrain. Natural conditions such as varieties of flora and fauna for nature study, and water amenities, for swimming, boating, and fishing are added advantages.

The slope of land, its ruggedness, and internal soil drainage affect the cost of constructing transportation routes to or across depleted sites. The soil texture, depth, drainage, slope, and organic content influence agricultural treatment of the site. Cropland, pasture, and timber production can use land ranging from gentle to rugged topography.

## Site Improvements

Normally, the cost of regrading a site for residences and other uses greatly exceeds the initial value of the unimproved land. Because of this, housing should be set into areas where the proposed or operation-caused topography is residential in character (i.e., grades not exceeding fifteen per cent). Finish-grading the site for roads and buildings will depend on the type of development design (either single-family, row apartments, or mobile homes as instances) and surrounding landscape (Fig. 11).

Regrading for agricultural and recreational activities is almost as important as for residential uses. Improvements required are drainage, leveling, topsoiling, and the building of a soil structure of high fertility for plant growth. Often-used recreational sites near the urban fringe will require more intense final grading to insure field and court games, than sites with wilderness character. On the other hand, excessive improvements, such as eliminating ruggedness, may reduce the value for this use.

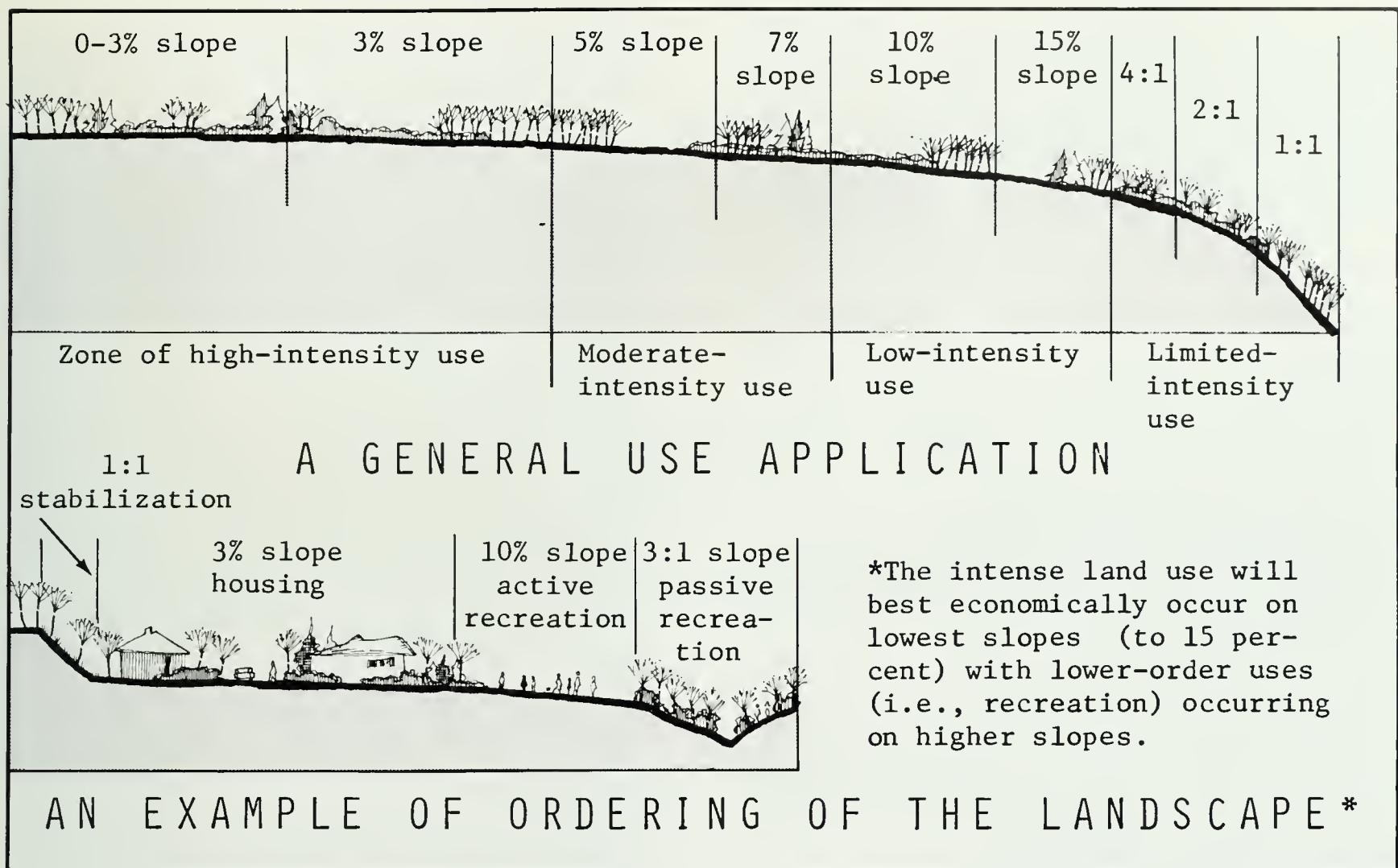
Perceptual conditions are evaluated in Figure 12 for Seven Knolls' conduciveness to the proposed Community College. (See also Fig. 27, THE SITE ANALYSIS).

## Intensity of Use

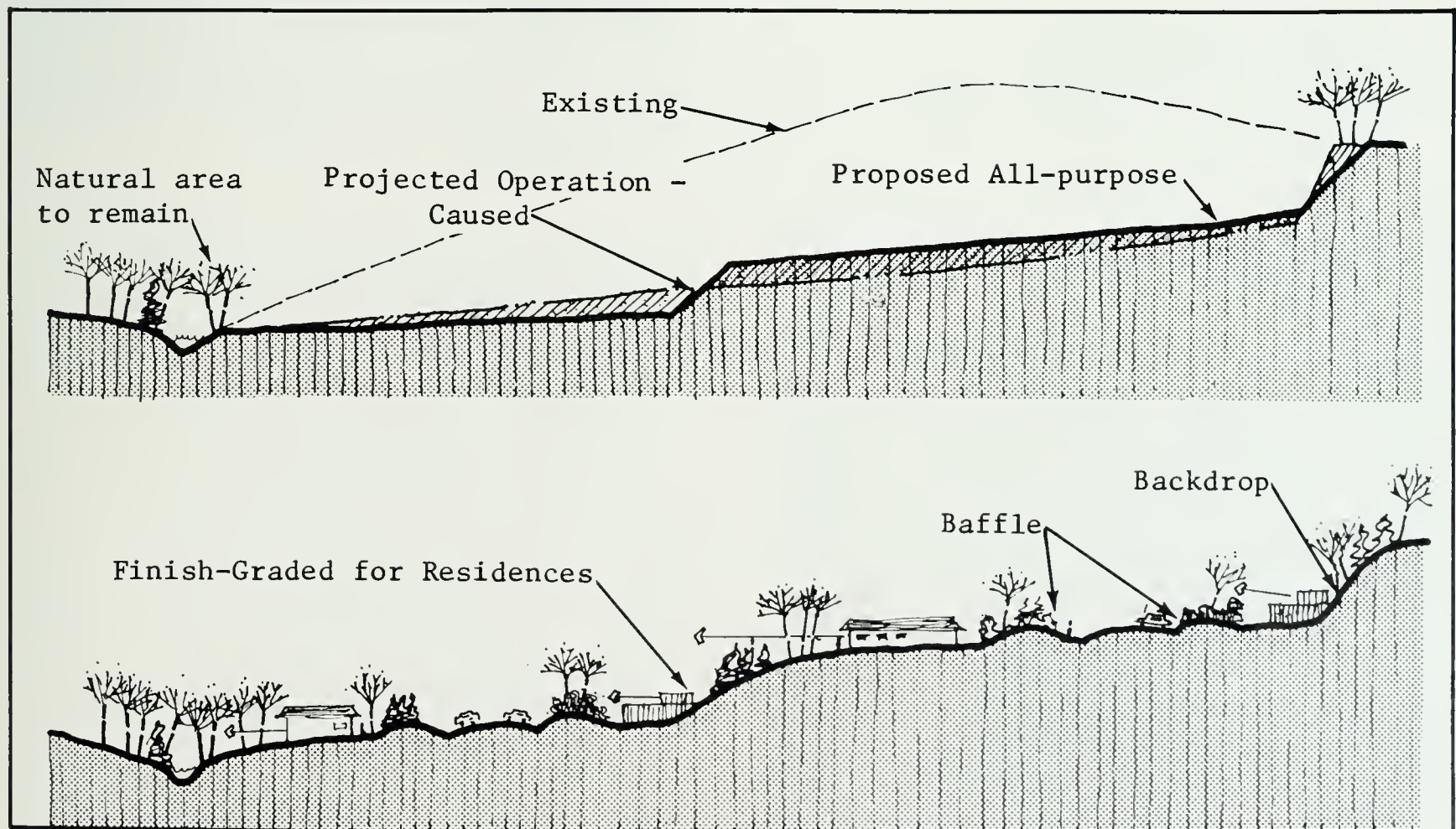
Zoning, extensive ruggedness, or some feature of the site such as a lake may limit the land available for actual development. Housing units allowed by zoning may also limit the degree of development or the use intensity of the site. Similarly, the size of industrial buildings may be limited by steep slopes or yield of crops restricted by poor quality soils.

In some instances deposition of the site can be insured by providing buildable land either through partial mining of the site or creating sanitary or wastesand fills when economically feasible to assure sufficient land for use. For example, a site which is mined except for the minimum set-back area may well leave the periphery lacking sufficient land for a proposed use, while varying the set-back width and creating peninsulas of wastesand material will not only provide adequate land but can increase the amount of land directly accessible to the lake (Fig. 13).





**Figure 9(A) — Relative Ordering of Land Use Referenced to Slope**



**Figure 9(B) — Provision of an Esthetic Landscape for Residences**



## SECTION 2

# Site Development

### Procedure

Developing a sand and gravel site cannot be done through a quick set of procedures. It is a lengthy process in which the feasibility survey and the development and adaptation stages must logically follow each other.

Development plans always find their justification or rationale in the objectives they seek. These may range from conservation of mineable land to the conservation of mined land that is feasible for use. Objectives of development plans for sand and gravel sites are designed to minimize problems and conflicts associated with early mining and optimize ultimate development for re-use of depleted sites.

Once the goals of an operation for final utilization have been decided, formulation of the development plans follows. This calls for more than the collection of factual data and analysis of the land use determinants. It includes decisions on a course of action, choice between alternatives, and specifications of what should or should not be done.

Most re-use planning for sand and gravel sites involves the following steps:

1. Research on the nature of the site before, during, and after excavation (Fig. 14 and 15).
2. Analysis of various options and requirements in terms of anticipated final site conditions.
3. Choice among alternative or combinations of alternative land use potentials.
4. Drafting of the development plan in written and graphic form.
5. Execution of the plan, which may show need for reformation of revisions.

From the initial mining decision to the final utilization of the site, considerable time will elapse in which a planning and operation schedule, coupled with a final master plan, should be used. There is no universal design for joining land and buildings just as there is no single process for the development of sand and gravel sites. The following, however, is a general schedule of steps which will lead to ultimate development.

### Feasibility Stage

This is the period before excavation which most operations call the retention period for future reserves. Depending on circumstances, this stage will start with purchasing the land or taking an option for its minerals. Feasible uses for the site should be selected during this stage and will depend on land characteristics such as site location, access, anticipated topography, and

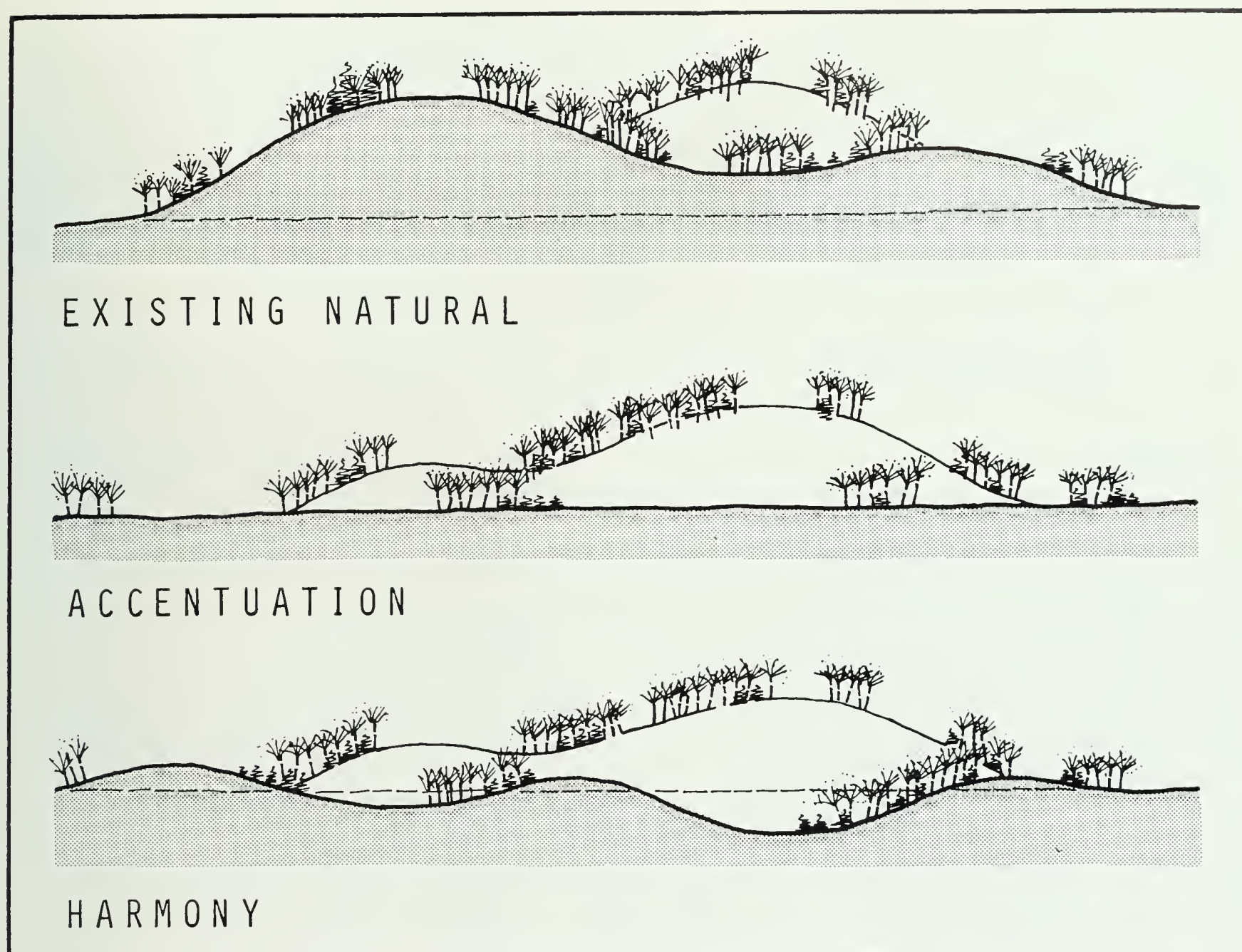
DETERMINANT	CRITERIA	EVALU- ATION	EXPLAN- ATION
Size	Is the site large, medium or small in relation to current demands for this use?	Fair	Small
Shape	Regular or irregular; will it curtail this use?	Fair	Irregular
Portion of Site Usable	What per cent; will this limit full use of the site?	Fair	Forty per cent
Sub-surface soil quality	Will it support proposed land use with standard construction techniques?	Good	
Surface soil quality	Available topsoil for anticipated needs?	Good	
Slope	How much unusable, limited or suited for use?	Good	
Elevation of site	Is it ridge or low-lying in relation to surrounding land; will position affect use?	Poor	Transitional treatment of cutbank required.
Floodplain	Floods seasonal, often, seldom; what is severity to use?	Good	
Inundation portion	How much of site affected by flood; detrimental to use?	Good	
Cost to Finalize Improvements	High, low or worth the bother?	Fair	Fill to adjacent elevation
Drainage—Surface	Fast, slow from where to where; will it affect final development?	Good	
Bedrock	Depth, extent; what will its affect on the final use be?	Good	
Watertable	High, low; will it be a problem, an asset; what is the affect?	Good	

**Figure 10 — A Checklist of Landscape Conditions of Seven Knolls and Their Desirability for a Community College**

usability of soils after excavation is completed. (A Community College has been suggested for Seven Knolls by The Maryland National Capital Park Planning Commission<sup>1</sup> while other use types in Chapter III illustrate the basegrade versatility). A range of uses may also be selected by what is suitable through economic, intangible esthetic, or community points of view.

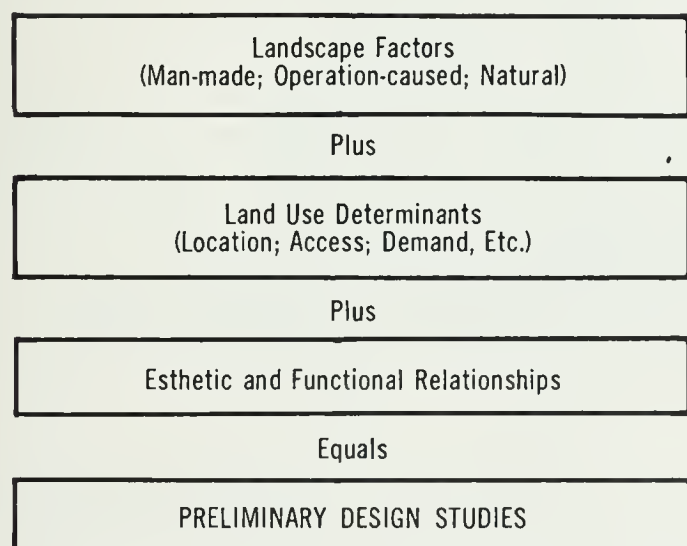
During this preliminary stage, the site and operation are examined for their influence on the land use potentials and one or more conceptual designs are proposed for the site. The studies completed during this stage will consist of land usage plans, analysis of natural and operation-caused conditions, and basic conceptual designs. In some instances, design aids such as existing (Fig. 17) and proposed models of the site or perspective renderings will better illustrate preliminary decisions for the site, and be excellent aids for proposal-acceptance by adjacent land holders and planning authorities. At this point the design studies are preliminary indications of the final result of the operation or the final use.





**Figure 11 — Effects of Basegrades on the Surrounding Landscape**

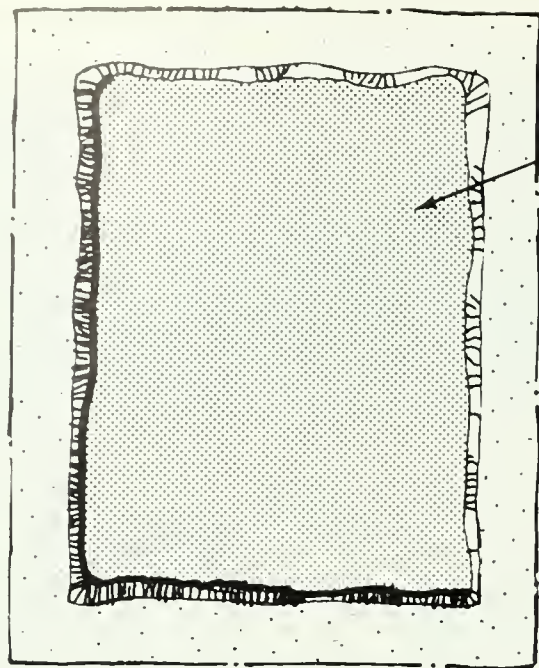
Besides taking into consideration esthetic relationships of proposed uses, preliminary design studies will be a direct result of land use determinants, and of natural, man-made, and operation-caused environments:



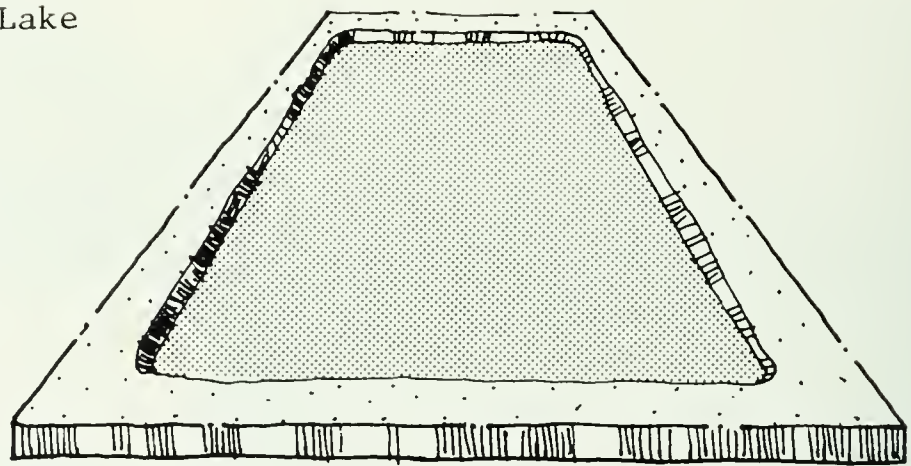
DETERMINANT	CRITERIA	EVALUATION	EXPLANATION
Amenities	Are natural or cultural available on or near the site; influence?	Good	Good existing natural values. Cultural values are proposed.
Character	Is the operation-caused site conducive to this use?	Fair	Fill required for excavations.
Noise	Problem, nuisance, permanent; will it affect use?	Fair	Emanates from Interstate 95 and other main routes.
Odor and Dust	Same as above.	Good	
Hazards	Permanent, dangerous to whom, extent; affect on use?	Fair	Access across and nearness to Interstate 95.

**Figure 12 — A Checklist of the Perceptual Values of Seven Knolls for a Community College**

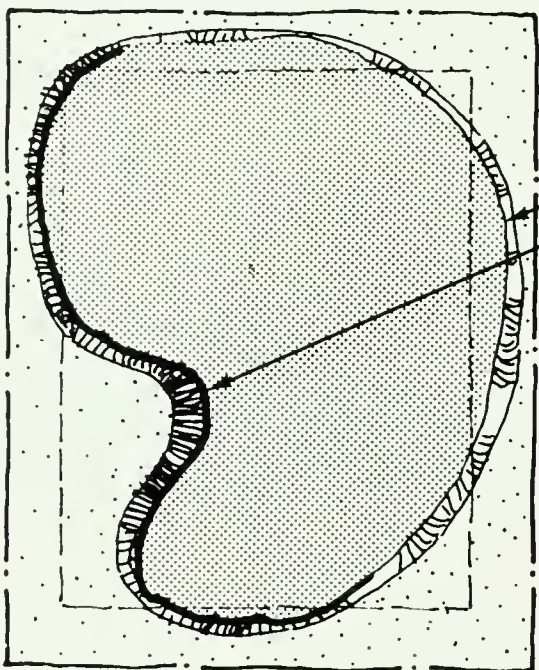




Lake

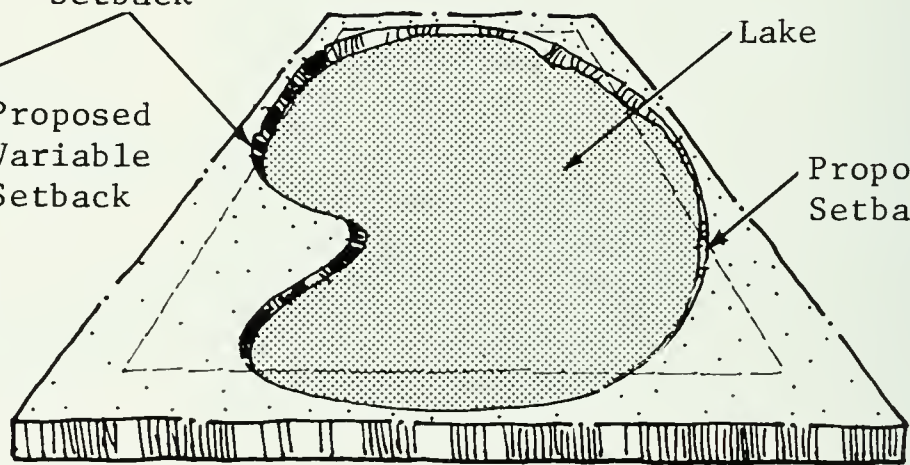


RECTILINEAR FORM



Setback

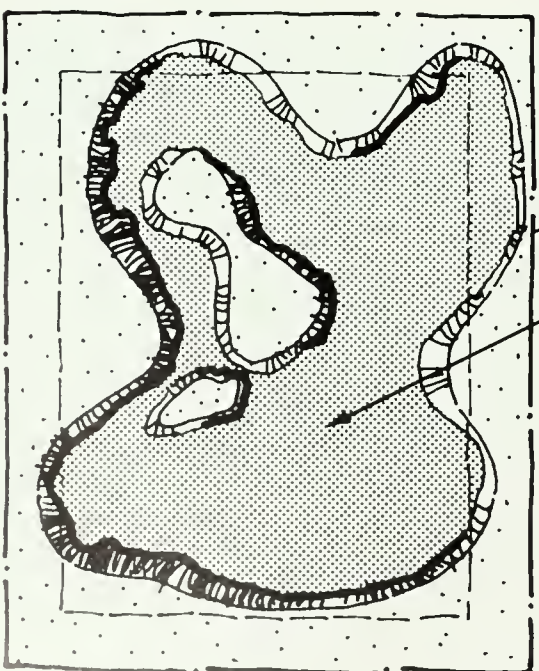
Proposed  
Variable  
Setback



Lake

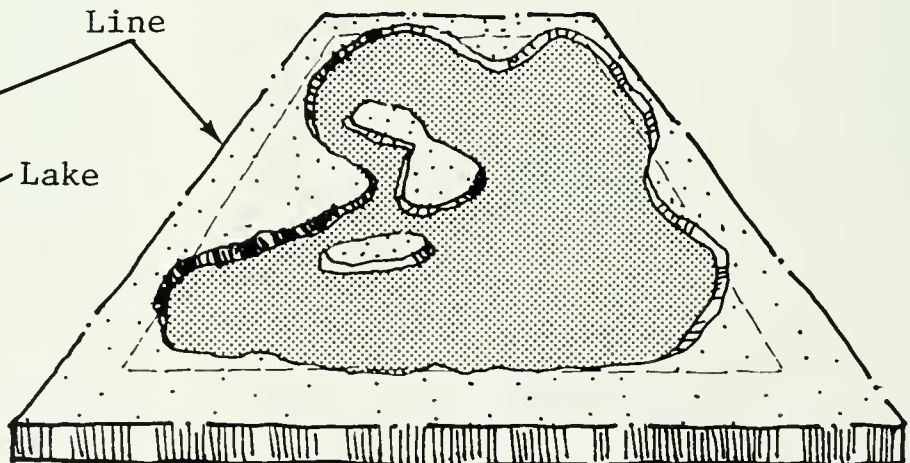
Proposed  
Setback

FREEFORM



Property  
Line

Lake



NATURAL FORM

Figure 13(A) — Lake-Form Potentials with Constant Property and Lake Size





Figure 13(B) – A Varying Setback Can Produce Interesting Areas

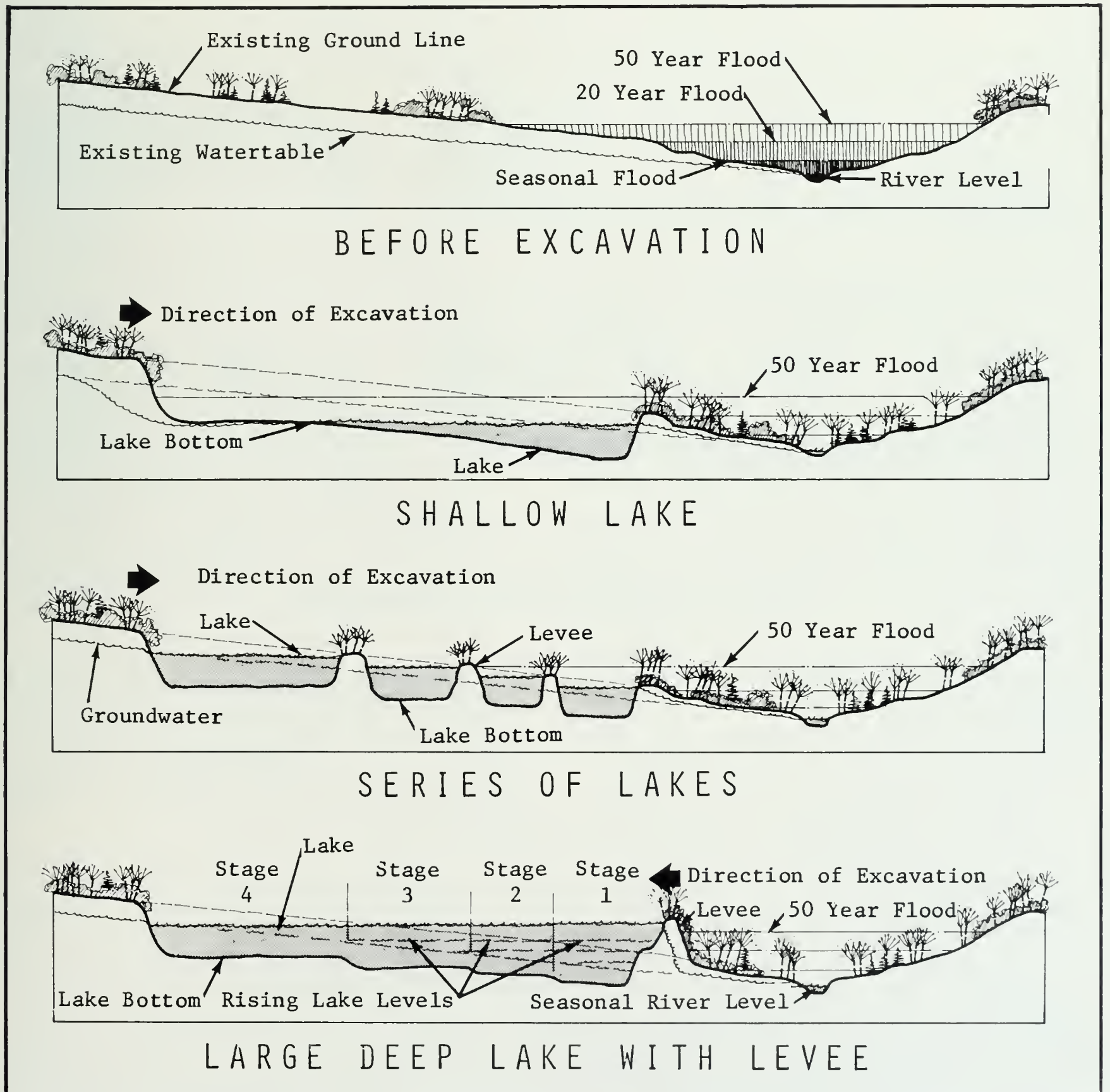
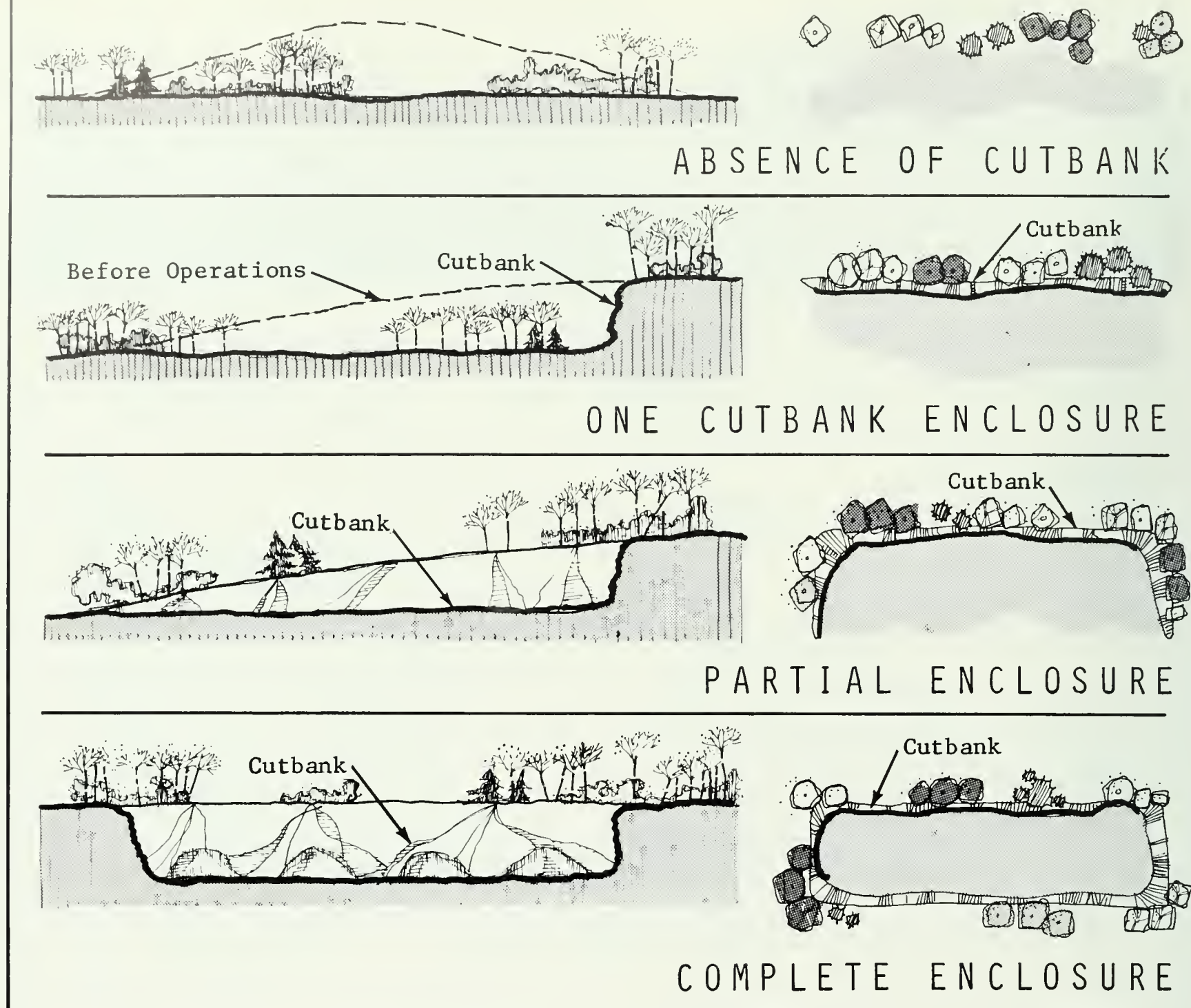


Figure 14 – Landscape Conditions and Origin of Wet Pit Types





**Figure 15 — Landscape Conditions of Dry Pit Forms**

Site analysis of the conditions which affect the re-use potential of a sand and gravel site involves knowledge of the following factors:

1. External conditions which affect the *selection* of a land use, such as the environmental conditions: location, surrounding land use, demand for a particular use, proposed use for the site by zoning, environmental changes, and the duration of the excavation.
2. On-site conditions which will affect the *design* of a selected land use such as the physiographic conditions: climate, geology, ground water, topography, natural vegetative conditions, and the operation-caused features and forms.
3. Miscellaneous conditions which affect the *selection* and *design* for a land use are the economics involved in adapting a site, technological advances, operation potentials, and the site improvements needed.

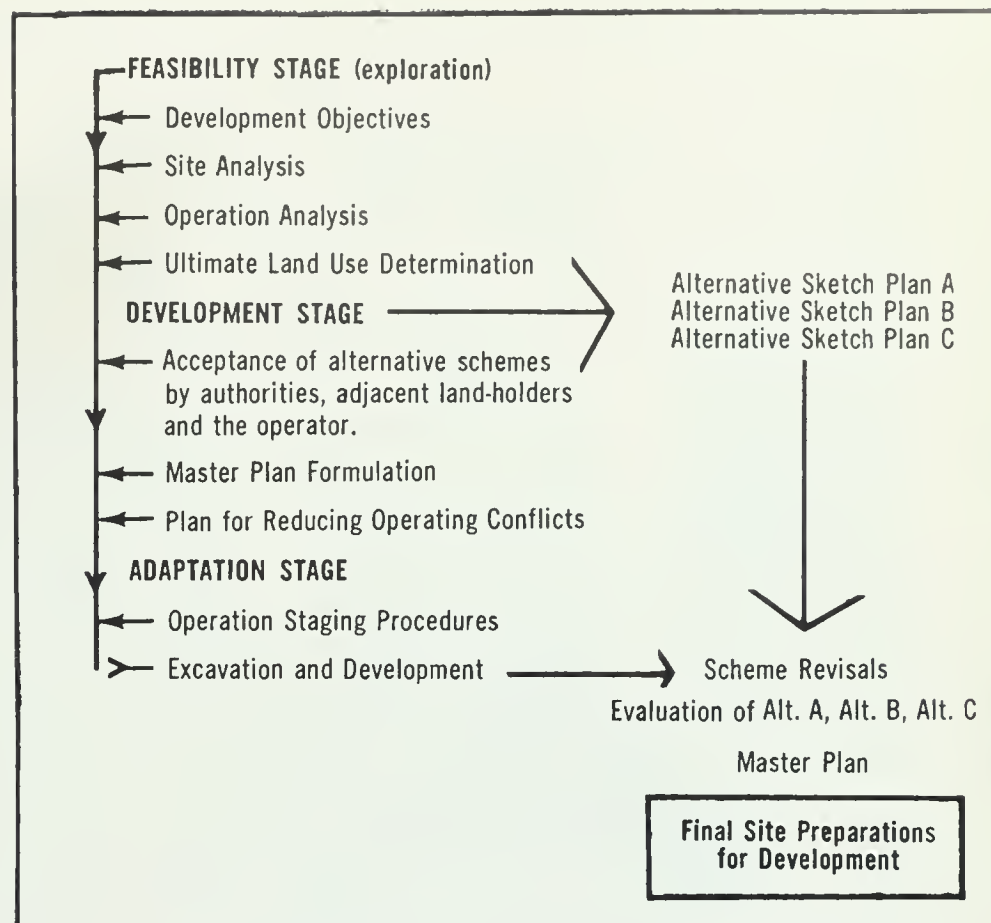
The site analysis, which is completed before excavation commences, should not govern the final land product because of possible changes in operational characteristics and final site features and forms. Rather, the site analysis at this point should indicate the possible resultant forms of the operation, and embody the following provisions:

1. Sufficient development area.
2. Buildable topography for maximum site utilization.
3. Maximum accessibility.
4. Maximum retention and use of natural and desirable operation-caused conditions for landscape character.

After accumulation of data from the initial survey, graphic presentation of all the factors affecting the use of the depleted site might be contained in the following:



1. Site location study (Fig. 5).
2. Analysis of existing patterns and trends for development from available land use and zoning plans, including data on agriculture, subdivisions, and rural development, commercial uses, industrial and public facilities, churches and schools, parks and recreation, and highways (Fig. 18, EXISTING LAND USE).
3. Projections of future trends for the above uses (Fig. 19, PROPOSED LAND USE).
4. Analysis of existing natural and man-made values such as the water features and resources, (steep and flat land, forest cover), individual and row buildings, roads, ridge lines, utilities, railroads and land ownership (Fig. 5B and 20, THE CASE STUDY and CHARACTER DETERMINANTS).
5. Analysis of deposit quality and amounts of overburden and unmineable material for re-use as fill, land forming, and screen mounds (Fig. 21, DEPOSIT LOCATION).
6. Analysis of existing soils to determine quality of topsoil and amounts available for use (Fig. 22, SURFACE SOIL CONDITION).
8. Analysis of the soil immediately below proposed operation-caused basegrade to determine land suitability, location of bedrock, and poor quality soils.
9. Analysis of the proposed operation-caused conditions such as water features, topography, forest cover, or fill areas (Fig. 25, 26, 27, TOPOGRAPHY and SITE CONDITIONS).
10. Analysis of the relationship between the best land, land limited for conservation, or low intensity use (Fig. 28 and 29, SLOPE ANALYSIS and SITE SUITABILITY).
11. Land treatment map, showing preliminary decisions for buildable land, fill areas, and sketch plan for ultimate development (Fig. 36A and 51A).
12. Additional revisions of the preliminary basegrade and preparation of a topographic map embodying the ultimate basegrade to which the operations will be oriented.



**Figure 16 — Planning and Site Development Schedule**

### Development Stage

During this phase, the conceptual studies for the site are revised to incorporate suggestions from various authorities, institutions, and business interests as well as to conform with zoning and building codes so that permits can be secured readily. Results of the preceding stage are now consolidated and incorporated into operation patterns to guide the excavation. These excavation patterns, either crescent or strip, as illustrated in Figure 30, for Seven Knolls, may be used to best produce the desired land forms. With an organized approach to the operations, the excavation then begins in a manner of optimum control to facilitate ultimate development (stripping, stockpiling, excavating and finish-grading). The proposed master plan (which is more elaborately

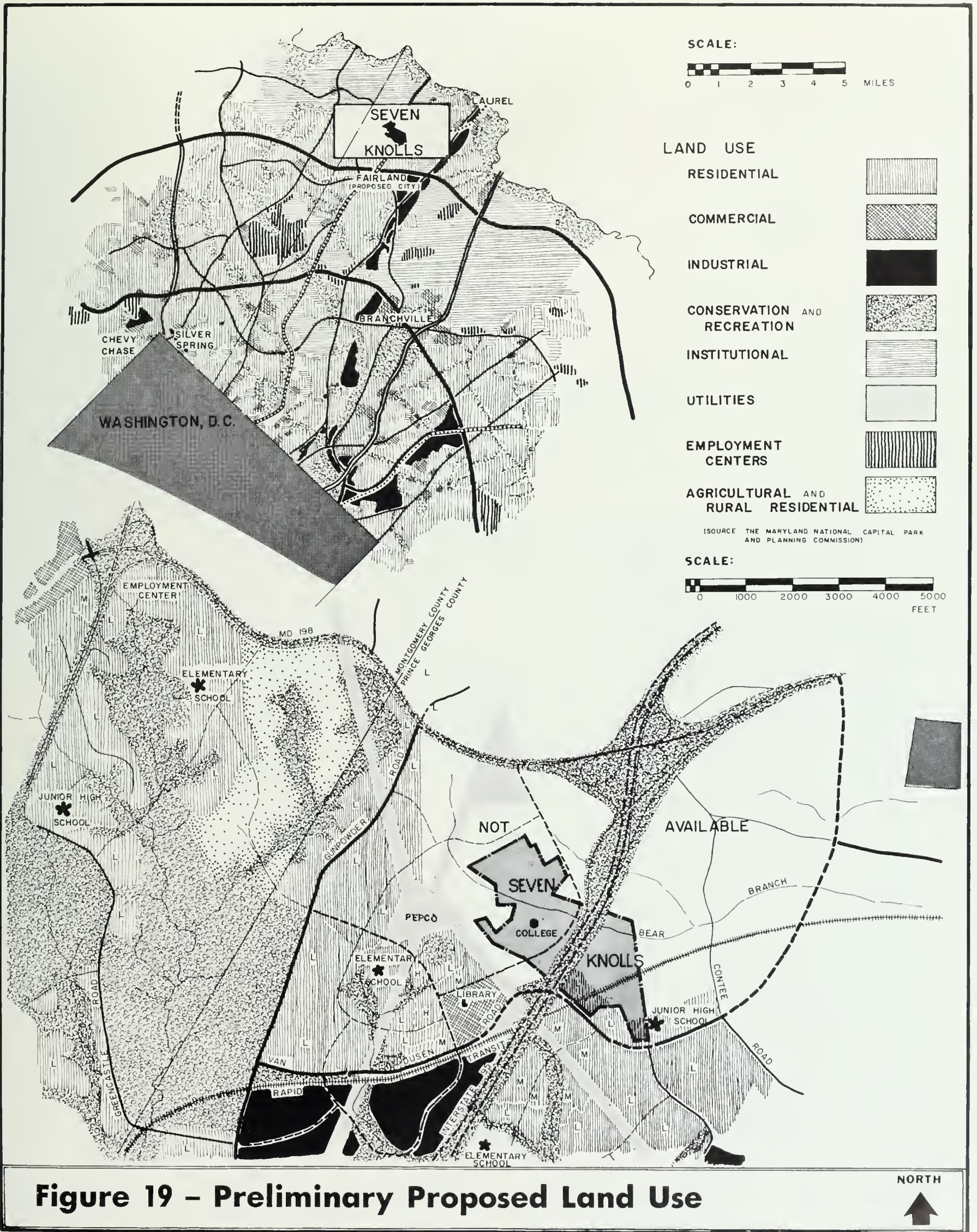
**Figure 17 — Seven Knolls Before Excavation—A View to the West**



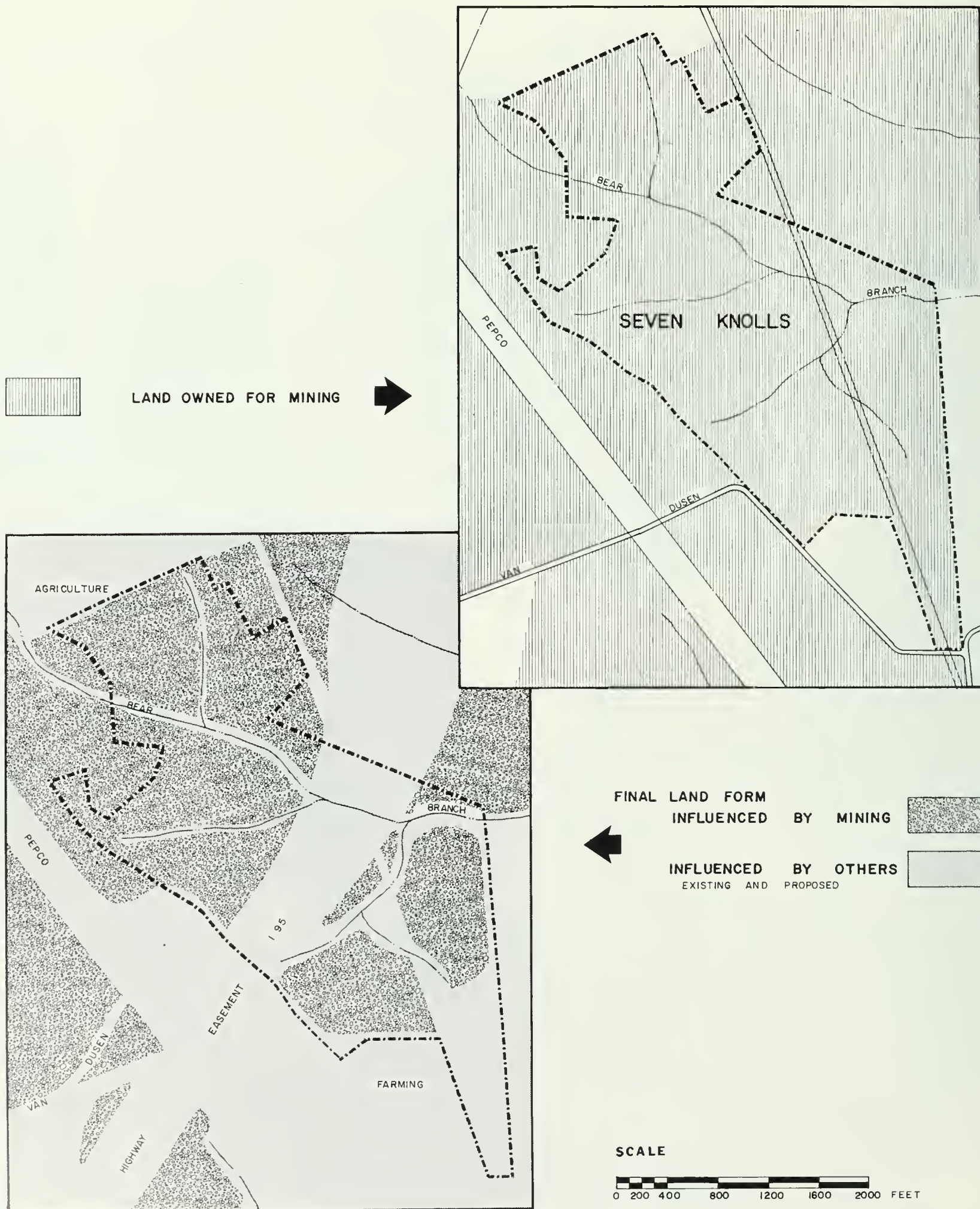






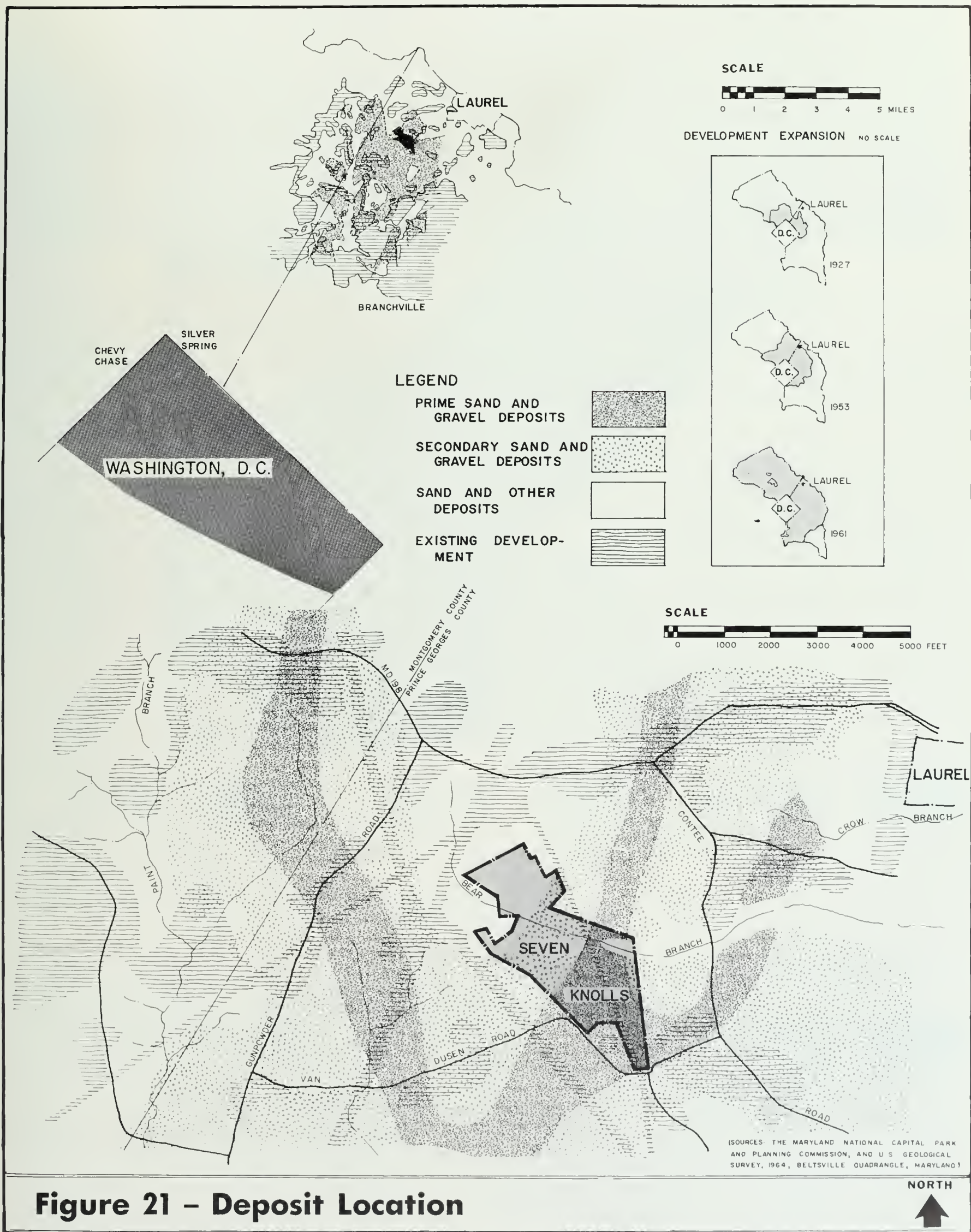






**Figure 20 – Character Determinants**









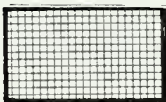
**SASSAFRAS  
GRAVELLY LOAM**  
(to 40 inches deep)

1. Good for crops on smooth land.
2. Fruit growing should be successful.
3. Warms early in the year.
4. Trees occurring: Chestnut oak, black walnut, black locust, red oak, hickory (in wet areas), catalpa, sweetgum, holly, ash, sycamore, hornbeam, elm, willow, and birch. Second growth is Pinus virginia.
5. Best for forest crops — low yield food crop — pasturage is fair.



**MEADOW**  
(very deep?)

1. Texture from gravelly sand to clay with drainage internally generally deficient.
2. Best suited to pasture and some areas for hay.
3. Trees occurring are willow, birch, sweetgum, swamp maple, elm, beech, poplar, and black ash.



**TUXEDO SOILS**  
(undifferentiated)  
(to 48 inches deep)

1. Varies in texture from heavy clay to sand and is subject to erosion when cleared of forest.
2. Some areas with liming and manuring can be made more productive with best use for forest pulpwoods.
3. Small forest trees occur — chestnut oak, white oak, black oak, sassafras, pine. In wet areas — birch, elm, and sycamore with the sand and gravel areas best for Pinus virginia.



**SASSAFRAS LOAM**  
(to 40 inches deep)

1. Subsurface drainage is generally good.
2. It is a good agricultural crop soil though some liming is recommended.
3. Trees occurring are oaks, gum, poplar and pine.



**LEONARDTOWN  
SILT LOAM**  
(to 30 inches deep)

1. Underlain by hardpan 6 to 15 inches thick and may begin 18 to 30 inches below surface — subsequently drainage is poor.
2. It is an important agricultural soil but requires liming. Very good soil when hard pan is broken.
3. Virgin forest — white oak, red oak, black oak, spanish oak, chestnut, and post oaks, holly, hickory, dogwood, cedar, maple.



**SUSQUEHANNA  
SILT LOAM**  
(to 18 to 30 inches deep)

1. Underlain by heavy clay consequently internal drainage is poor.
2. With applications of phosphates and lime this is a good soil though not considered a good agricultural soil.
3. It is predominantly a forest soil with oaks, gum, maple, and elm occurring.

Figure 22 — Surface Soil Conditions<sup>2</sup>





**Figure 23 — Existing Buffer Planting and Character of Adjacent Land**

discussed in Chapter III) should be flexible as the operations proceed to meet variations in landscape conditions and off-site influences.

### **Adaptation Stage**

As the excavation of each phase nears completion, the master plan should be finalized and the basegrade finished to meet the requirements for the selected use. At this point, each stage of the development may be completed or the total development delayed until the site is completely excavated and finish-graded. During this adaptation stage, establishment and maintenance of the seeded and tree-covered areas will insure a more mature character for the final development (Fig. 31).

### **Summary**

For a large sand and gravel site these planning stages, as prerequisites to effective simultaneous excavation and development, will be more pronounced and clearly defined. For small sites, the development may be consolidated and combined into fewer, less explicit stages. Sometimes years elapse before improvements and excavation are completed and the site is ready for use.

Whether or not a development program will prove successful depends primarily on cost, the expected benefits, and the time period which will elapse before the development is completed. The following specific points are important:

1. The quality and duration of planning and skill displayed to adjust to changing conditions.
2. The operator's ability to choose effectively between alternative land use types which will meet operational capability or community development programs.
3. The investment, in added operations, for a successful development.
4. The impact of the development program on the community and neighbors.
5. Economics of the final adaptation.



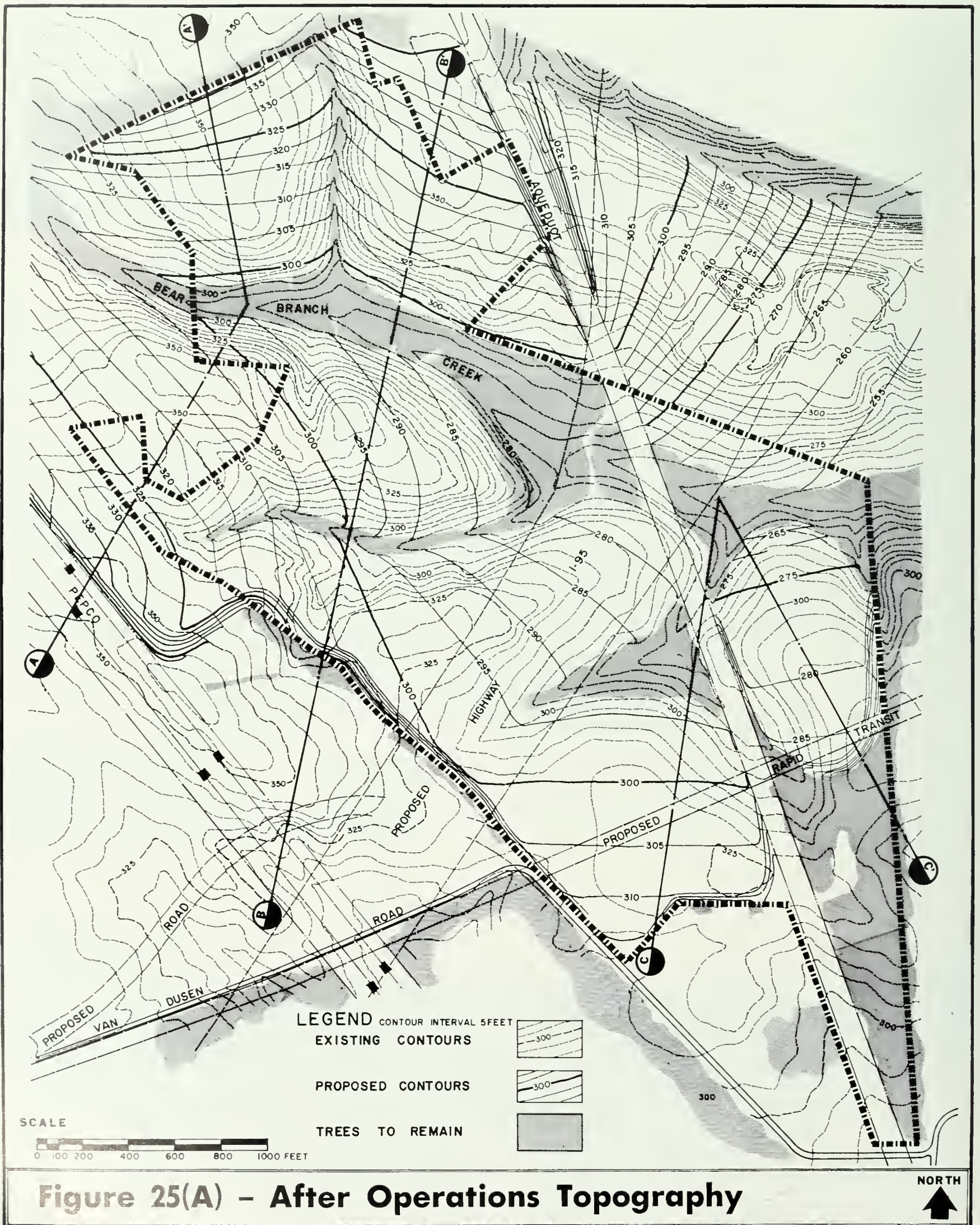
### **REFERENCES**

- <sup>1</sup> MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION, *Preliminary Plan for Fairland-Beltsville and Vicinity*, August, 1965, Silver Spring, Maryland.
- <sup>2</sup> U. S. DEPARTMENT OF AGRICULTURE, *Soil Survey of Prince Georges County*, Maryland, No. 30, Series 1925, Maryland Agricultural Experiment Station.

**Figure 24 — The Deposit and Terraced Excavation**









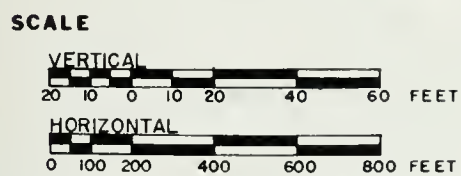
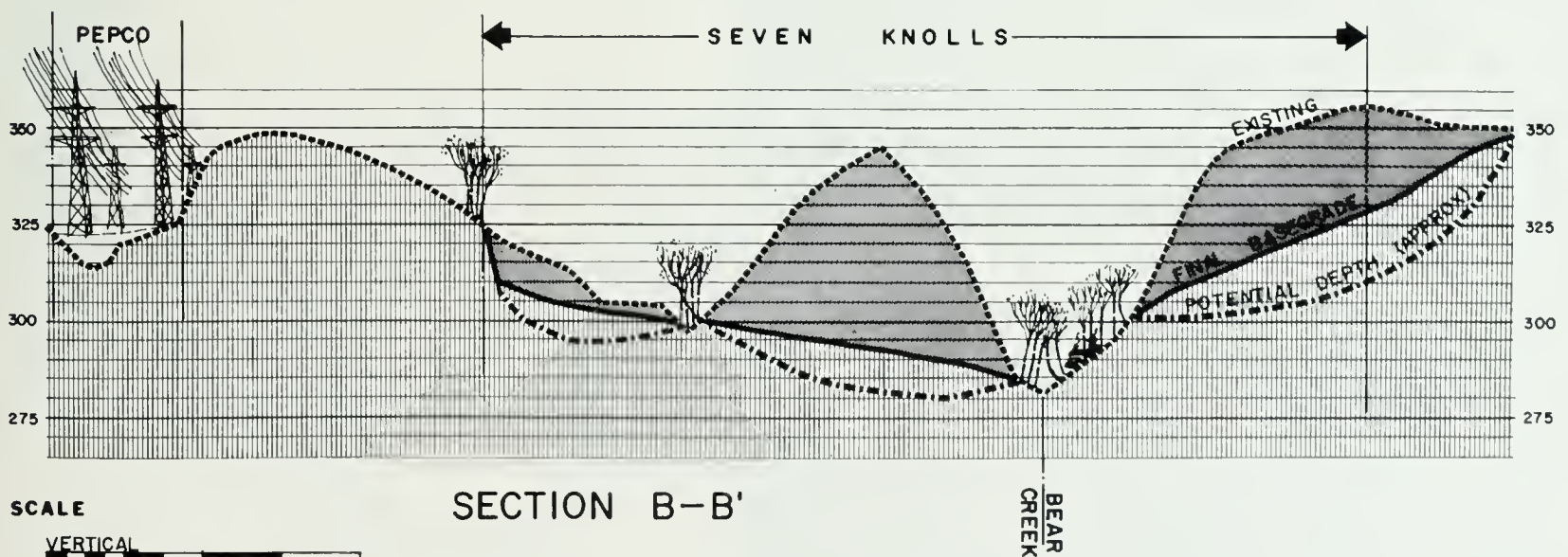
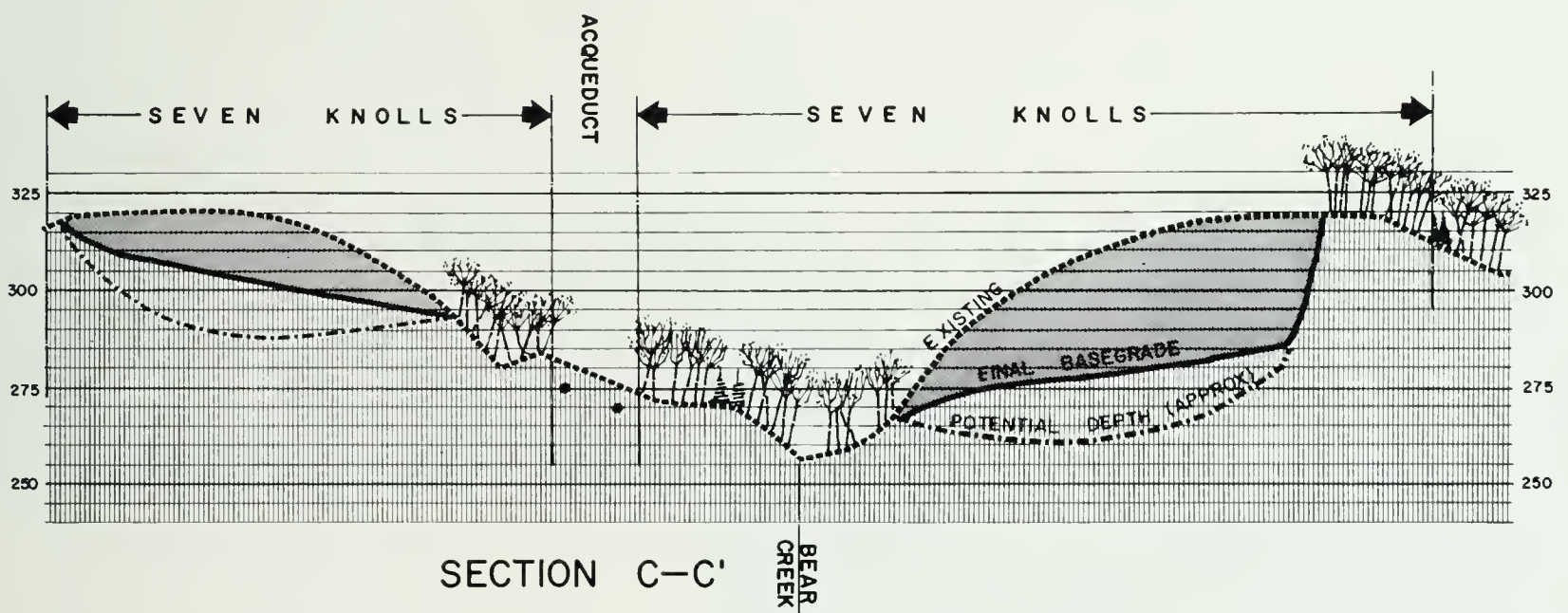
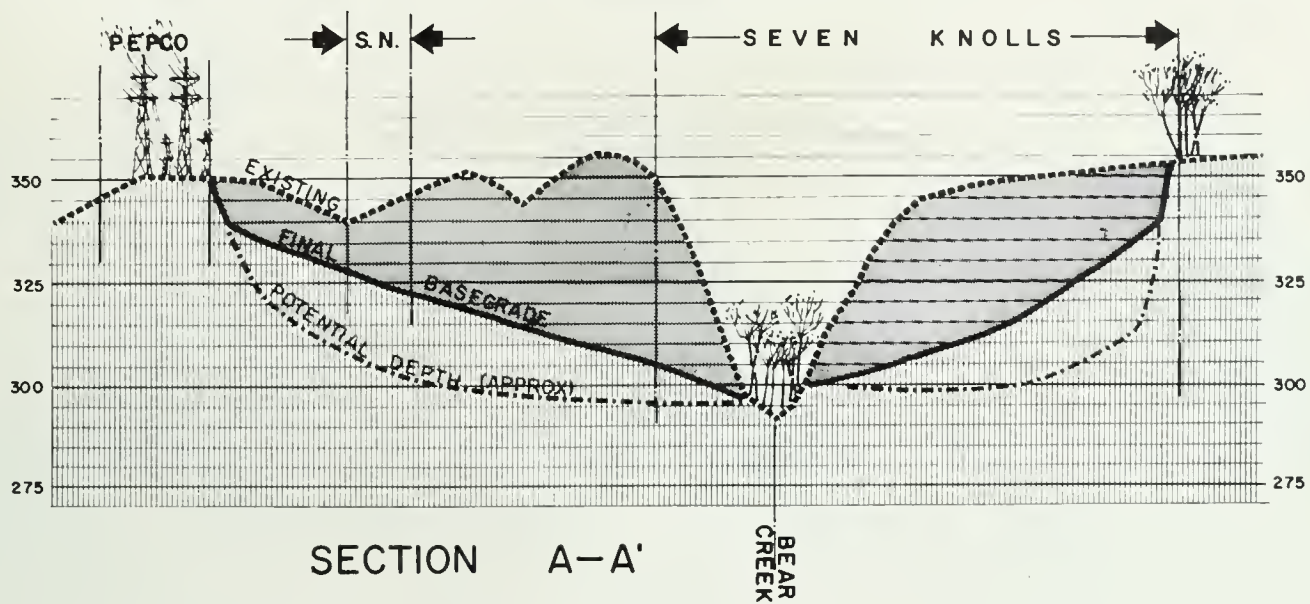
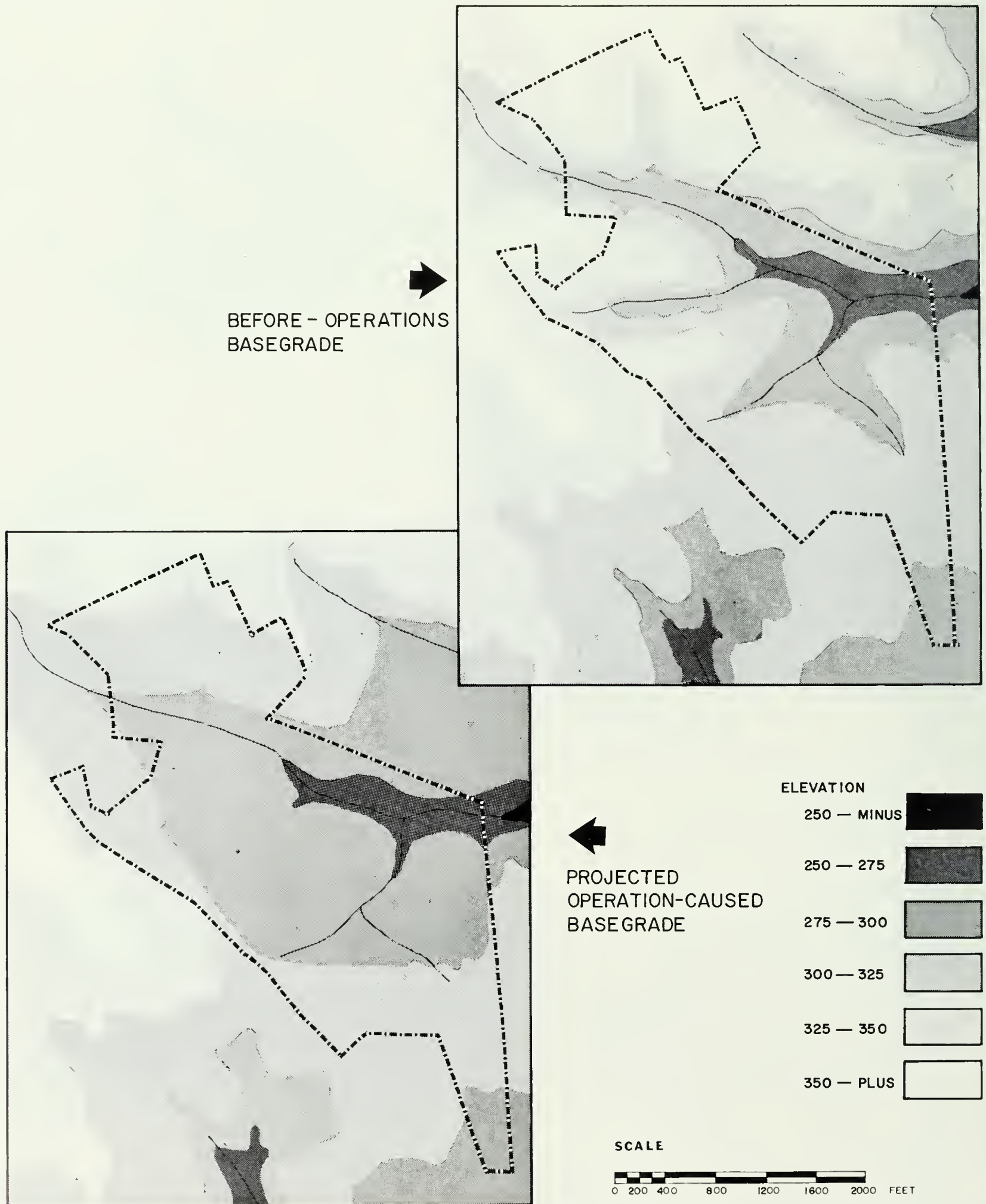
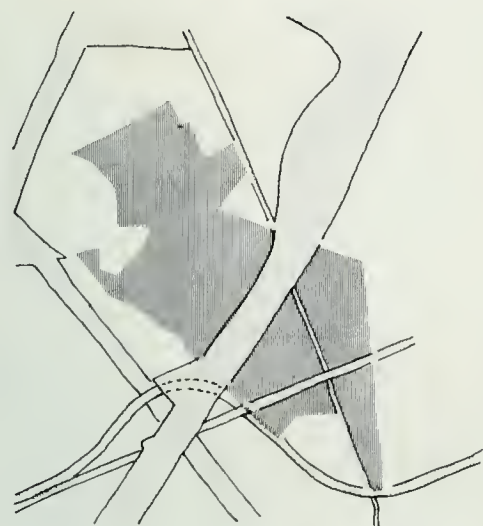


Figure 25(B)





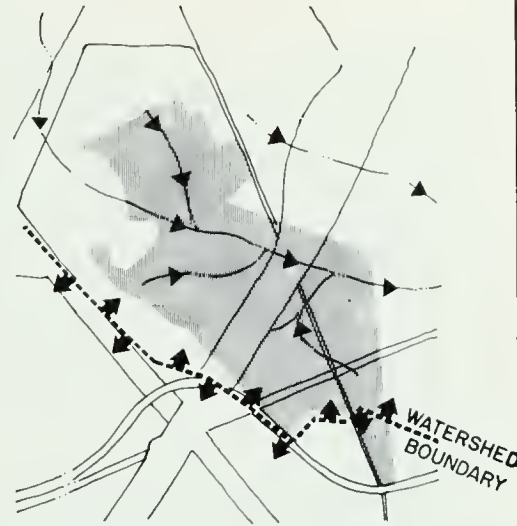
**Figure 26 – Elevations**



PUBLIC SERVICES



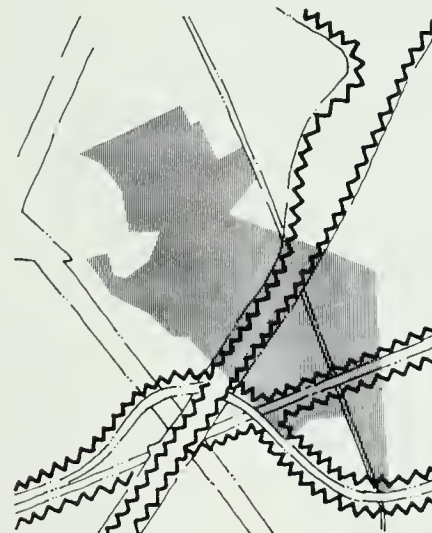
STEEP SLOPES



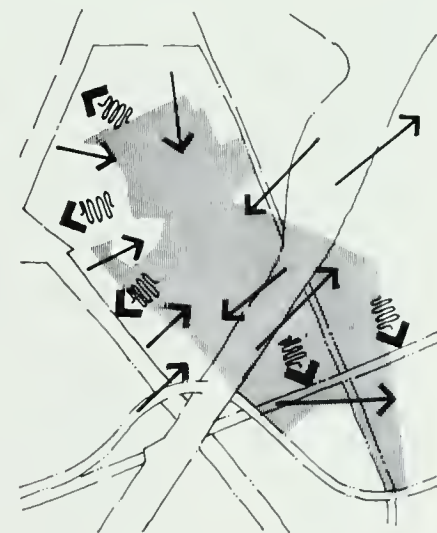
SURFACE DRAINAGE



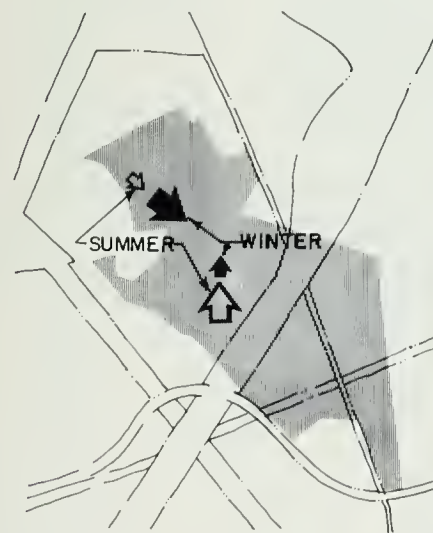
TREE COVER



POTENTIAL NOISE



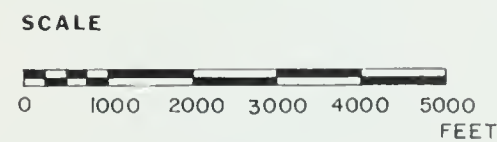
VIEWS



WINDS

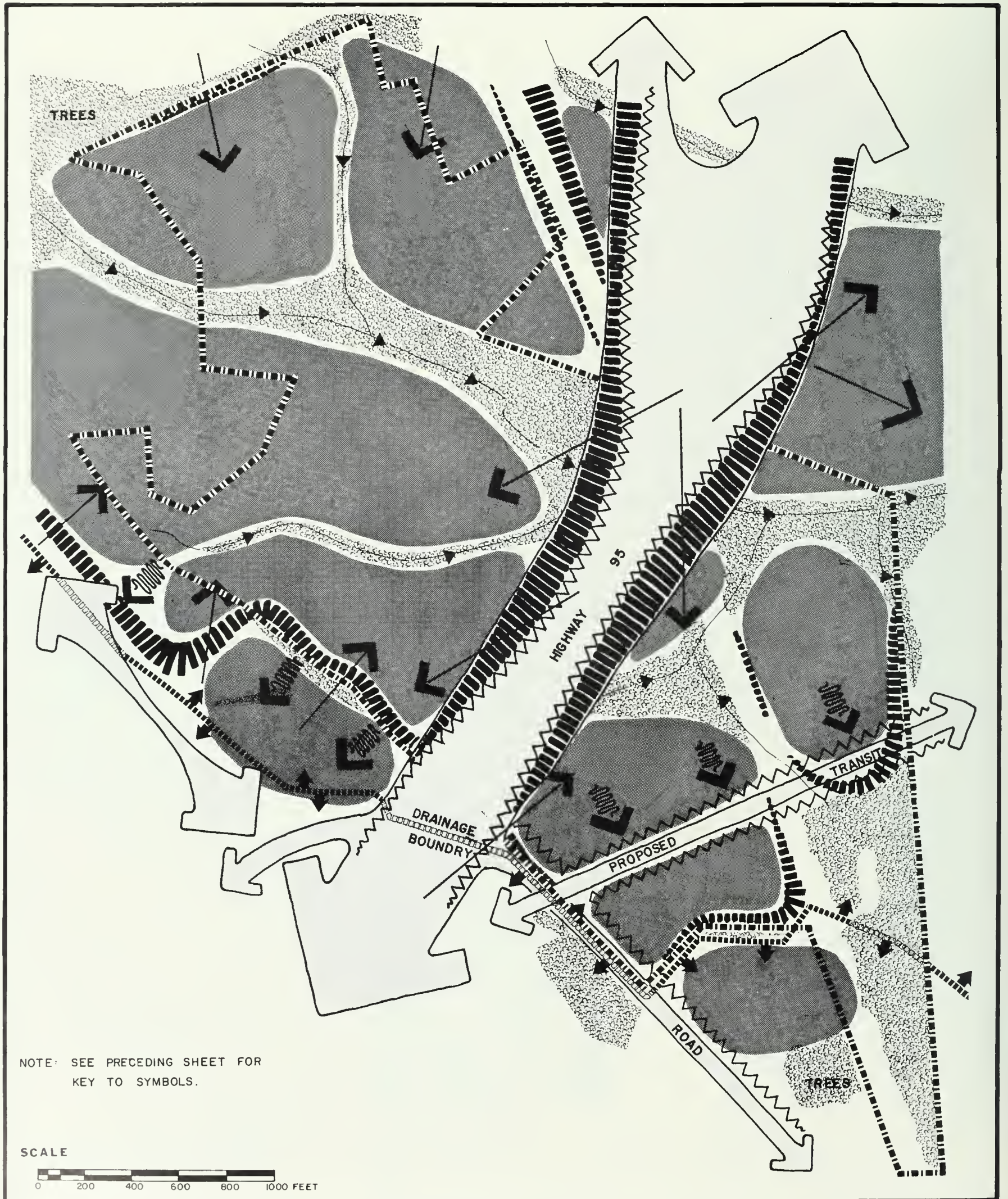


PERCEPTUAL AREAS

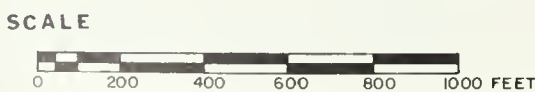


**Figure 27(A) – Site Conditions After Operations**





NOTE: SEE PRECEDING SHEET FOR  
KEY TO SYMBOLS.



**Figure 27(B) – Site Conditions After Operations**





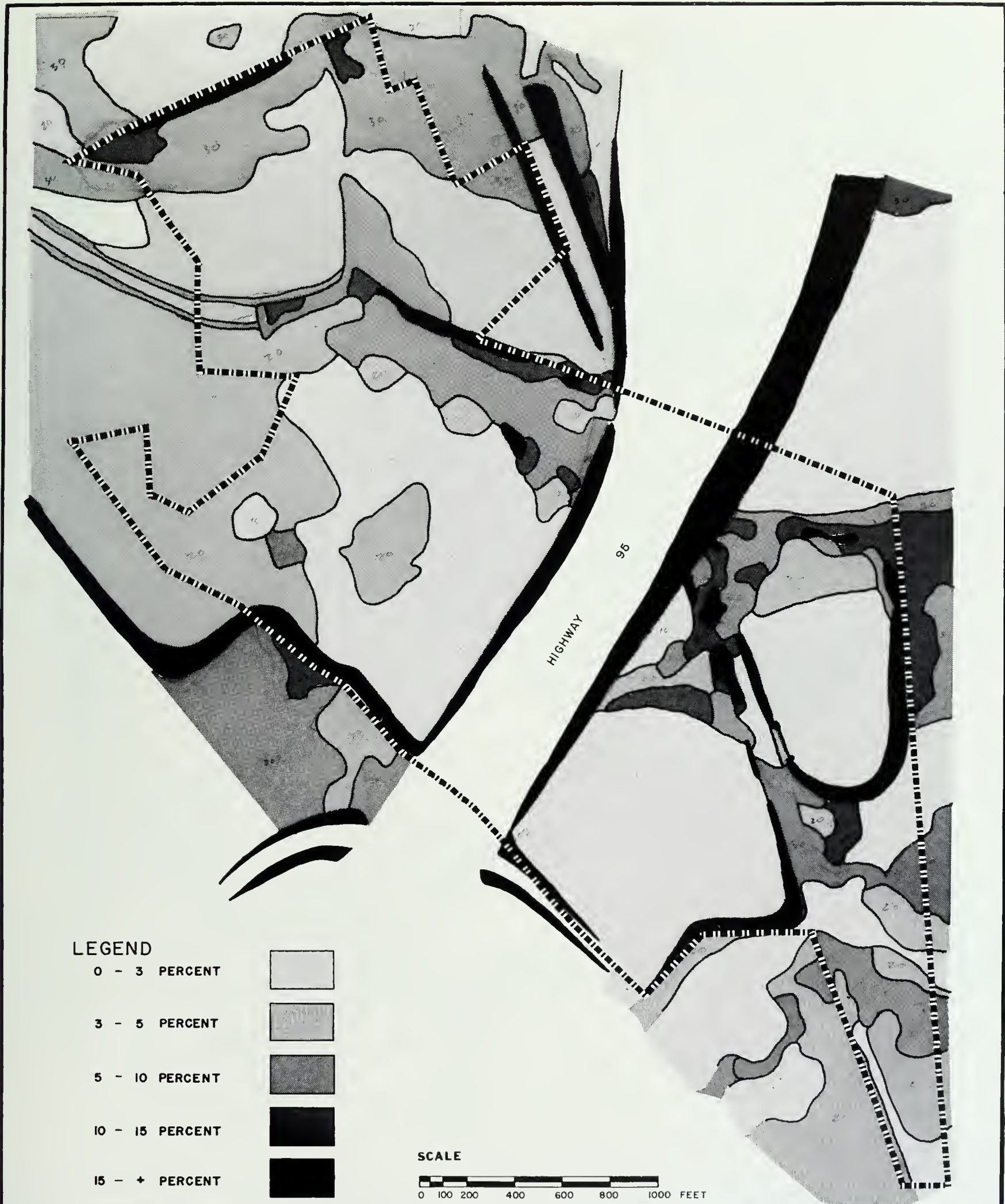
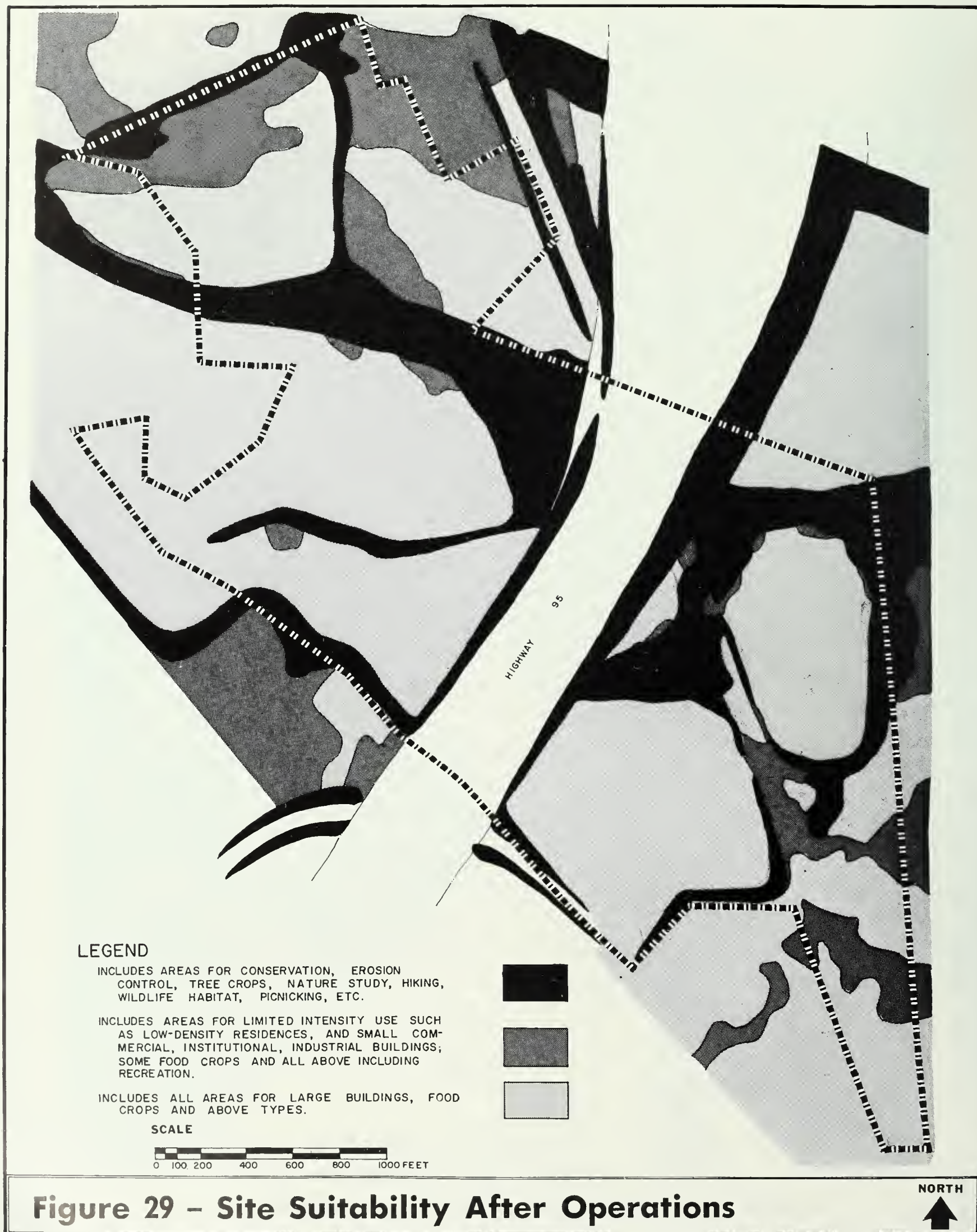
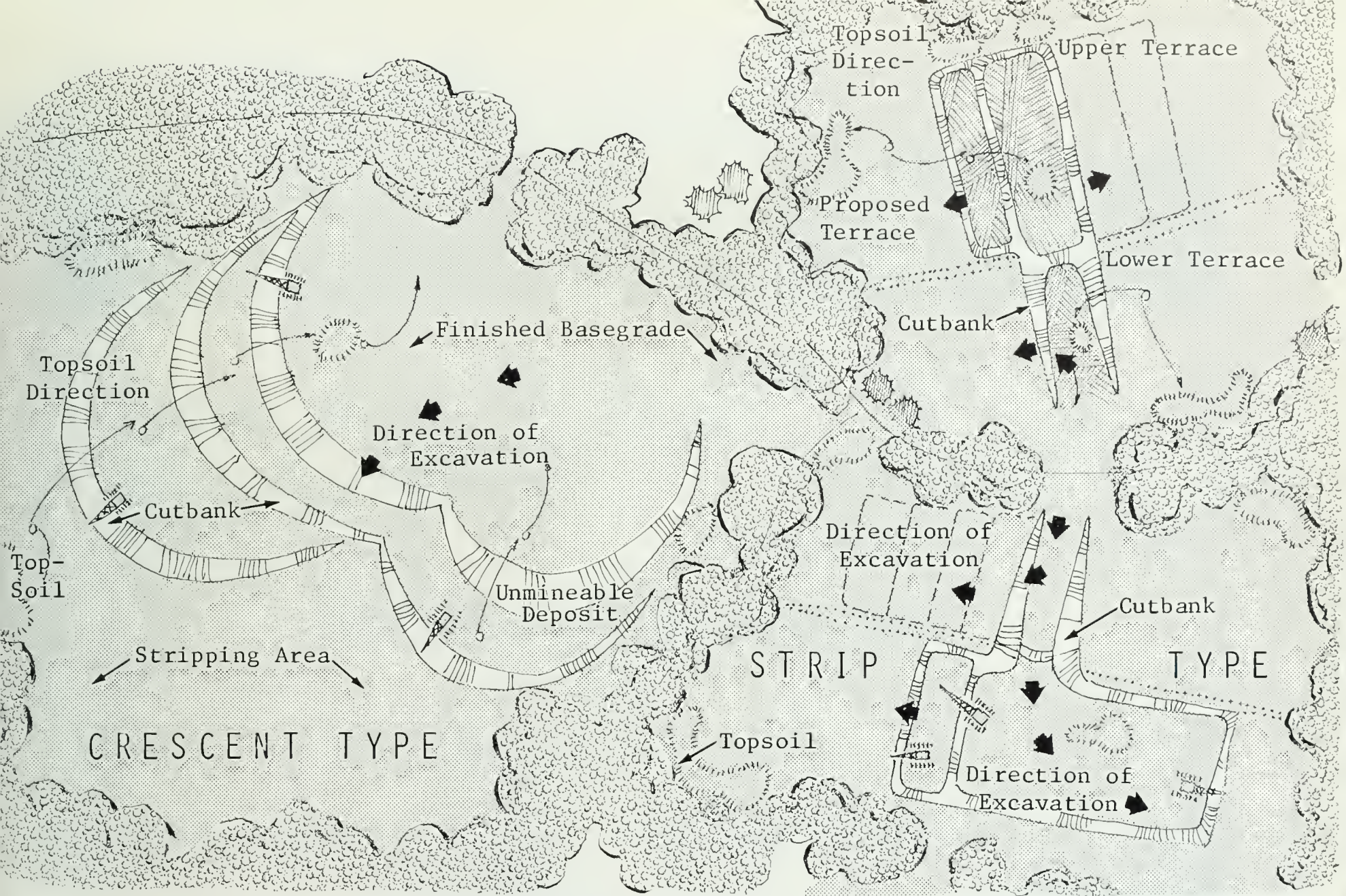


Figure 28 - Slope Analysis After Operations



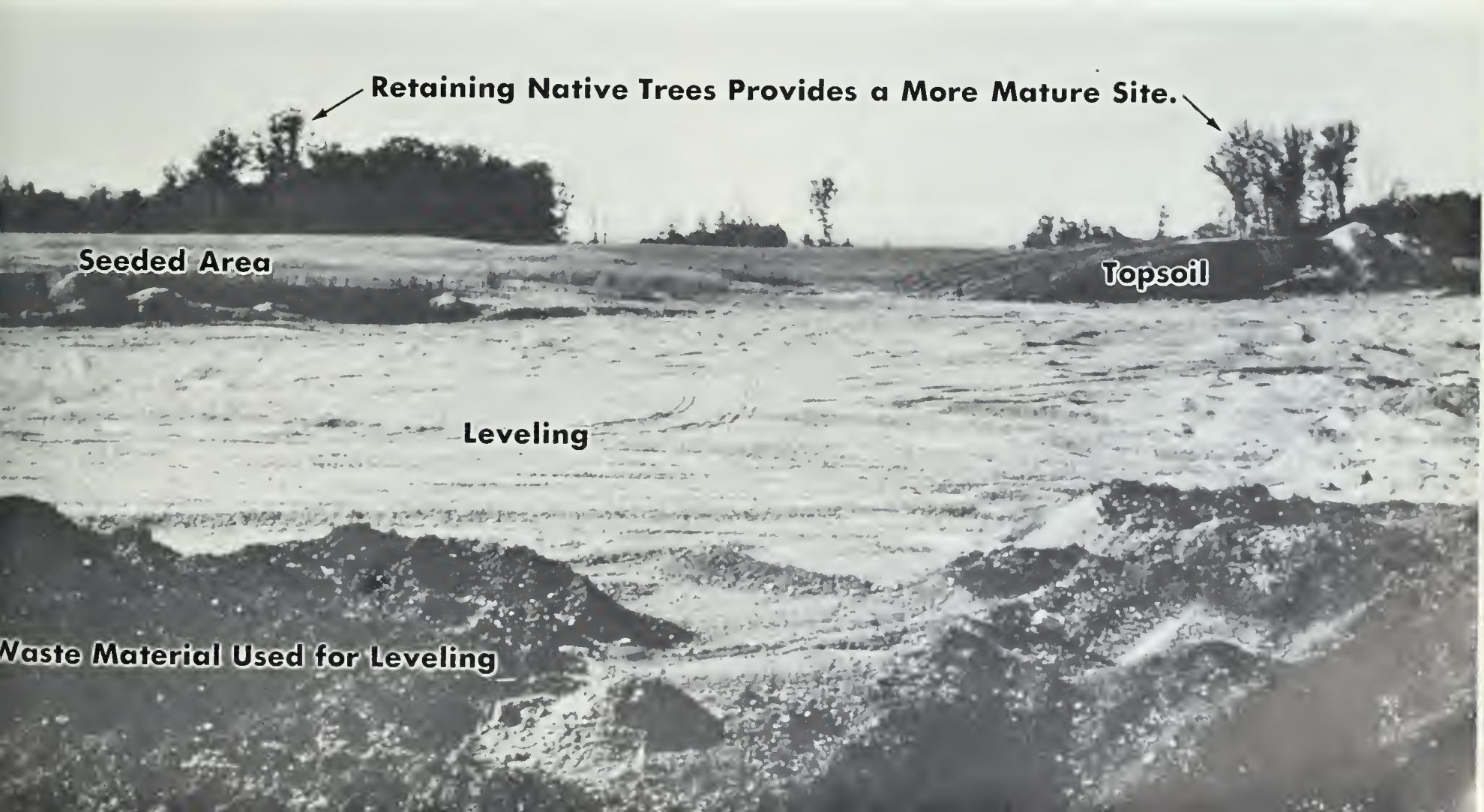






**Figure 30 —General Methods of Excavation**

**Figure 31 — Providing A Site for Final Development**







**Figure 32(A) — Maximum Integration with Natural Surrounding Character**

## *Chapter 3*

# Land Use Potentials

## **Introduction**

The physical factors affecting the selection and development of a land use are numerous, involving the surrounding land use, site location, site conditions and others as indicated in the previous chapter. It is the intent in this chapter to enumerate upon the land use categories and present examples of each with descriptions and accompanying plans and sketches to illustrate final site development. Detailed requirements will be examined, in conjunction with the methods and procedures for final adaptation, and site preparations will be illustrated which make operation-caused conditions of Seven Knolls better suited for each use.

Thus, each of the problems and opportunities of the site will be treated individually and collectively and in more detail than the previous section until all elements for the final development are in balance. The function of the final design and adaption will be threefold:

1. To make the most of the usable space provided by the excavation.
2. To fulfill the functional needs of the land use types.
3. To satisfy the esthetic values of the land use types.

Land development potentials for sand and gravel sites vary greatly and are only limited for use by the site's potential for satisfying their requirements. However, some types of use will be more apt to occur because of the community demand. This demand is generally typical with that of Santa Clara County, California in which, 3.6 per cent of the land is used for commercial, while industrial is 5.6 per cent, residential

is 43.3 per cent, streets are 23.3 per cent, and the public uses occupy 14.6 per cent.<sup>1</sup> It is apparent from these statistics certain land use types will occur more frequently than others.

Typical examples of land use have been selected for this chapter to illustrate final site development and are the following:

1. Planned Residential Development
2. Commercial Development
3. Institutional Development
4. Industrial Development

While agriculture and recreation are important use types, they have not been treated separately in this chapter. These two types are discussed where they pertain to the other land uses. A future report will deal with the topic of recreational usage.

This dry site, Seven Knolls, is used to illustrate the diversity of operations and the potential of a site for development. Besides finish grading and insuring esthetic landscape conditions for each use, plans have been used to illustrate the changes in operations needed to produce final conditions conducive to the selected use. The point here is that even though this site will be generally suited for all land use types, in terms of the abundance of buildable slopes, the final site plans show how much more optimunly the site can best be suited for a selected land use by taking as the primary motive for all users the creation of a good physical environment. The development process is oriented to analysis of the needs and resources, creative landscape analysis of physical conditions, and organization of the execution of the design sequence, and graphic illustrations to initiate proper use of the master plan.



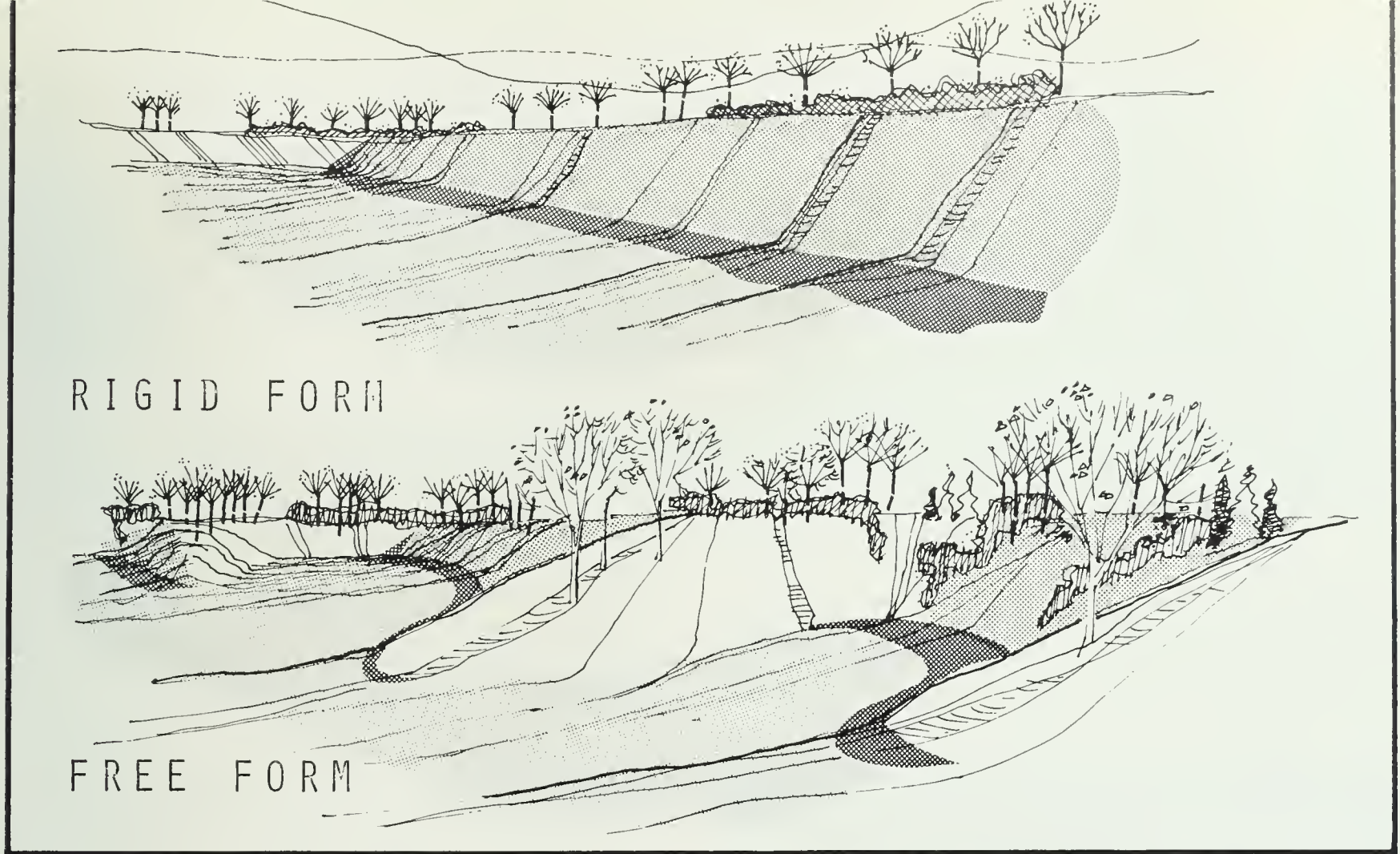


Figure 32(B) — Slope Treatment Alternatives

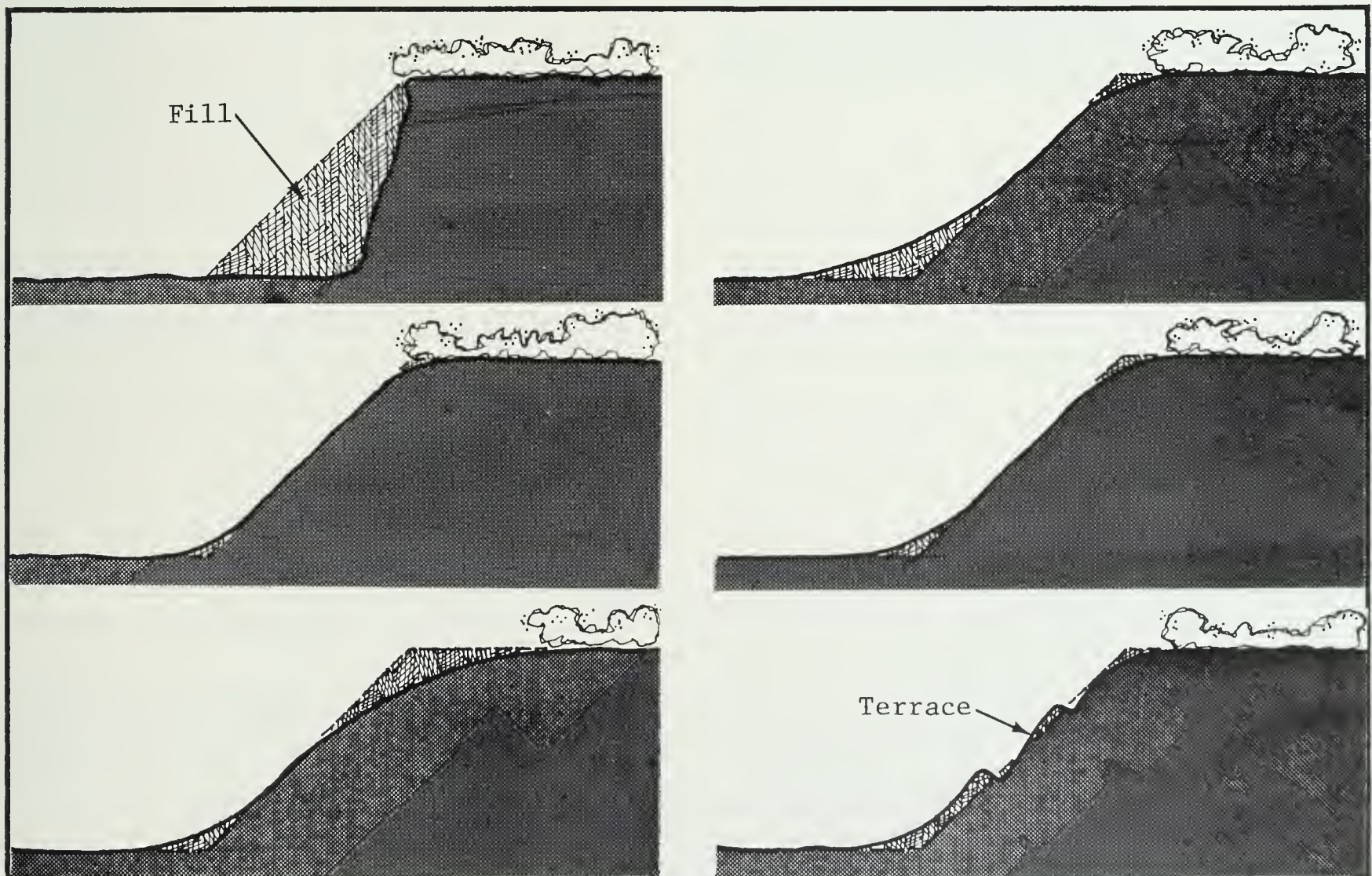


Figure 32(C) — Cutbank Treatment



On the case study site the adaptation is largely an engineering problem where the basegrade proposed is gently sloping. With imagination and control of operations, any potential use can be considered. Adaptation then is largely a technical and coordination problem between site condition, operations potential, and characteristic requirements of the use.

For adaptation of this site, attention should be given to the cutbanks and basegrade forms to minimize the visual affect of the operation. Efforts also should be made to grade natural forms so that in the end, grassy knolls may gently sweep up from Bear Creek and the character of the basegrade will be rolling and natural, providing integration with surrounding character (Figure 32). Natural forms should be selected to best suit the use rather than producing the all-purpose, good-for-anything basegrade. The site then can be better adapted for a selected use and be esthetically and economically valued more successful.

## SECTION 1

# Planned Residential Development

An examination of the varieties of potential uses would not be complete without a discussion of residential development, especially because of our expanding population with its accentuating demands for both housing and for the wise use of our most limited resource — land.

Availability of large sand and gravel sites in close proximity to cities can make the depleted site, with early planning, suited for development. The need for the wise use of resources equally places the producer in the "land-conversion business"; providing a dual or triple function for usable land (i.e., agriculture to mining to a relatively intense ultimate land-use such as residential). The number of households in the United States is expected to increase from 53 million in 1960 to 66 million in 1976 and to 97 million by the year 2000.<sup>2</sup> The Bureau of Census indicates that outlying parts of cities have grown six times greater than within the metropolitan areas, which signifies a need for the wise use of all available land for development in the suburbs.

The sand and gravel site, with residences planned as the ultimate re-use, is often a wise use of the land. Such a function of land suited for mining will require a knowledge of the following: (1) residential development types, (2) the requirements for a planned resi-

dential development, (3) the housing types and street patterns, and (4) the methods for adapting a sand and gravel site for residential use.

## Residential Development Types

In many existing residential developments, provisions were not made for recreation, schools, and community facilities. The reason lies in the fact that most developments do not occur in large acreages. The depleted site near the city is generally large (250 to 600 acres) and is therefore, conducive to planned residential development with at least 25 to 30 per cent of the gross acreage for community services and amenities. A planned development should insure good traffic circulation, ample parking, adequate community facilities, sufficient open space, and a basic order plus esthetic amenities.

Development occurring on the edge of cities and on sand and gravel sites may be of three types:

1. The planned community development (generally a satellite community of a large metropolitan area) will involve more than 1500 residential households, contain industry and satisfy all the needs of the people (recreational, social, educational, cultural, etc.).
2. The planned neighborhood involves not fewer than 50 families with facilities such as elementary school, community shopping center, and limited recreational facilities.
3. The subdivision, less than 50 acres, is merely an attachment to existing subdivisions and provides building lots with connecting roads.

## Planned Community Development

Though generally larger than most sand and gravel sites, planned community development is important in this discussion: a site for the larger development may contain sand and gravel deposits that can be mined prior to or simultaneous with development.

Knowledge and coordination of the mining activities with development plans for the community will result in financial rewards for the property holder. In some cases, the mining activities make amenities possible which ordinarily would not be available, such as a lake for recreation, level areas for industry, hospitals, commercial sites, and fill material for low-lying areas.

The aim of a planned community development is to provide a separate, self-sufficient living unit, independent of surrounding metropolitan centers and facilities. The concept of planned communities includes: industry to provide jobs, adequate shopping facilities, and amenities necessary for the residents to carry on a well-rounded social, cultural, and economic existence.

As an illustration of a planned community development, Reston, Virginia, when completed will include 10.5 square miles with facilities necessary for complete community living. Important in Reston is the atmos-





**Figure 33(A) – Maturity is Achieved Through Preserving Natural Amenities**

phere conducive to a satellite development. Much of the naturalness of the site has been preserved such as woods and topography with the new development exhibiting maturity (Fig. 33).

Planning and designing a community development involves coordination between landscape architects, engineers, planners, economists, architects, and others to satisfy the needs of the community and prepare a general master plan for development.

Residential areas within a planned community are generally diversified in cost and type. For a balanced community, the housing should be available to all income groups and be varied to meet the different needs of families, such as size of housing units, number of bedrooms, and housing types (apartment, townhouse, and single-family). Figure 34 indicates an idea for such a large development with emphasis on the general organization of the community and the relation of the functions within the community.

### Planned Unit Development

The second type of housing development generally involves smaller acreages than complete communities, lacking both industry and large shopping facilities. A

planned unit development is defined as a residential land subdivision of both rented and individually-owned homes and apartments with neighborhood-owned open areas and recreation facilities. It is a relatively new approach to a time-proven concept of residential land use. Basically, it incorporates a variation of the “village square” idea. It does, however, contain neighborhood facilities, with particular emphasis on accessibility and short distances. Facilities which can be included in neighborhood development or that require good proximity are as follows:

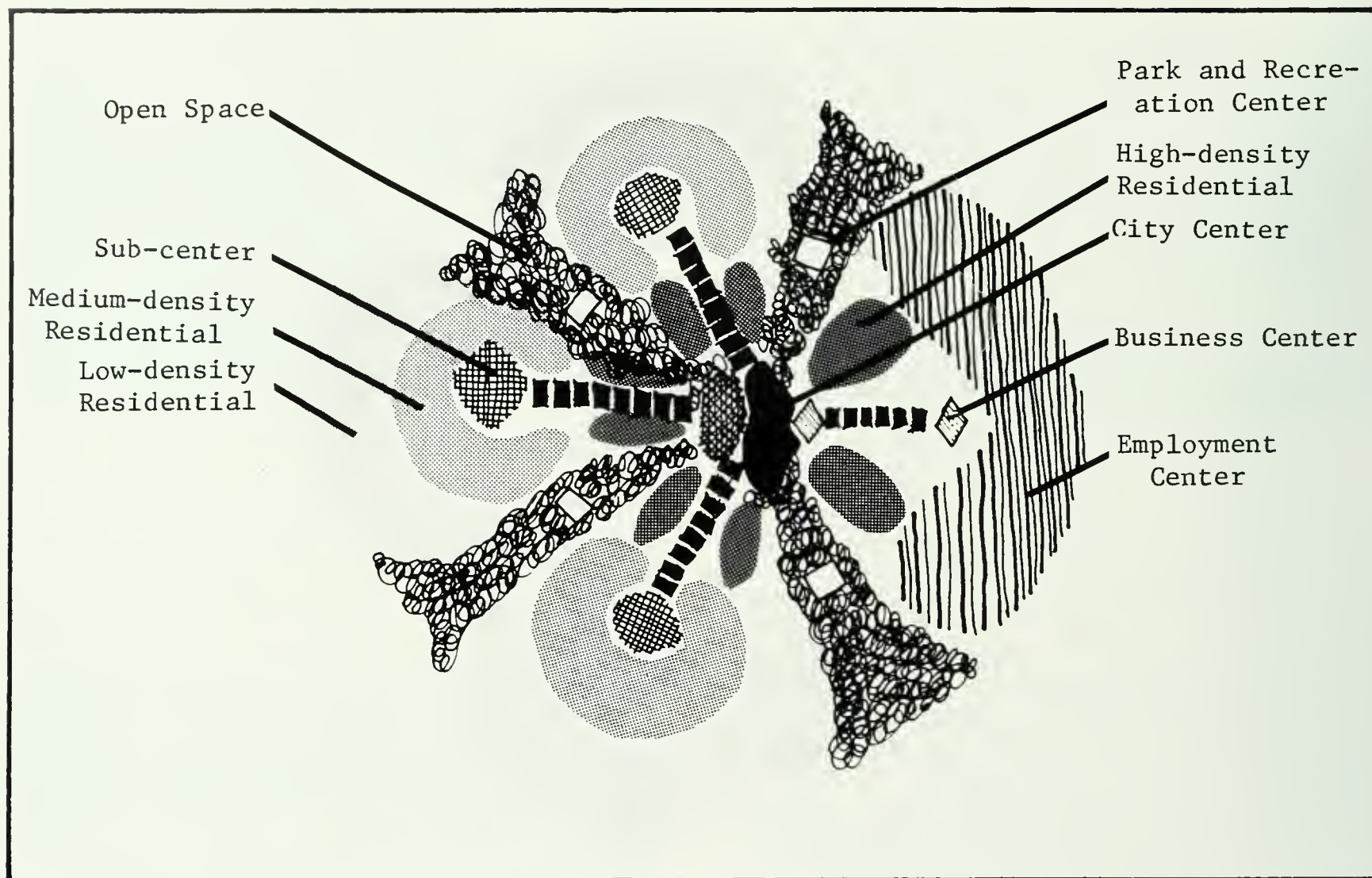
By walking:	By motor transit:
Elementary school	Senior high school
Junior high school	Large shopping district
Playgrounds and local parks	Public park or reservation
Playfields and recreation centers	Churches
Local shopping center	Employment centers

For all essential purposes a planned neighborhood is a geographic unit of between five and ten thousand people which may support its own education, shopping, amusement, recreational facilities, and social institutions.<sup>3</sup>

**Figure 33(B) – Creative Use of Natural and Manmade Conditions**







**Figure 34 – One Type of Planned Community Development Concept**

Coordination with existing zoning controls and with the municipal, metropolitan, or regional planning is a basic requirement. Beyond coordination with surrounding land uses, the developer of a neighborhood is obligated to supply a normal range of community facilities or to assure that those of adjacent municipalities are available. Consideration should be given to future trends for the area, such as intrusions of industry and airports that may have undesirable influences to insure long-range success of the neighborhood. In some cases, off-site influences may cause an adjustment of the site design to supply protection and greater self-sufficiency within the planned unit development.

The optimum use of land and maximum return for investment is not derived from the maximum density possible for a site. The suitability of an intensity varies with the site and situation, the allowable cost, the habits of the proposed residents, and the character of the proposed and surrounding development. Some of the housing types with increasing intensity of use are single-family, two-family duplex, row houses, walkup and elevator apartments.

The zoning ordinance of Frederick County, Maryland, includes planned unit development provisions. Section 40 permits flexibility and performance criteria which can result in developments that produce the following:

1. A maximum choice in the type of environments and living units available to the public (Figure 35).
2. Open space and recreational areas.
3. A pattern of development which preserves trees, outstanding natural topography, and geologic features and prevents soil erosion.
4. A creative approach to the use of land and related physical development.
5. An efficient use of land, resulting in smaller networks of utilities and streets and thereby lower housing costs.
6. An environment of stable character in harmony with surrounding development.
7. A more desirable environment than would be possible through the strict application of other sections of the ordinance.

Besides being predominately devoted to residential housing, a neighborhood development will need approximately 30 per cent or more of the gross acreage for one or more of the following land uses:

1. Elementary school and park.
2. Junior high school and park.
3. Church sites.
4. Neighborhood shopping facilities.
5. Streets and easements.





**Figure 35(A) — A Townhouse Clustering**



**Figure 35(B) — Apartment Clustering**



**Figure 35 (C) — Apartments on a Depleted Site Separated from Present Operations By a Wooded Ravine**



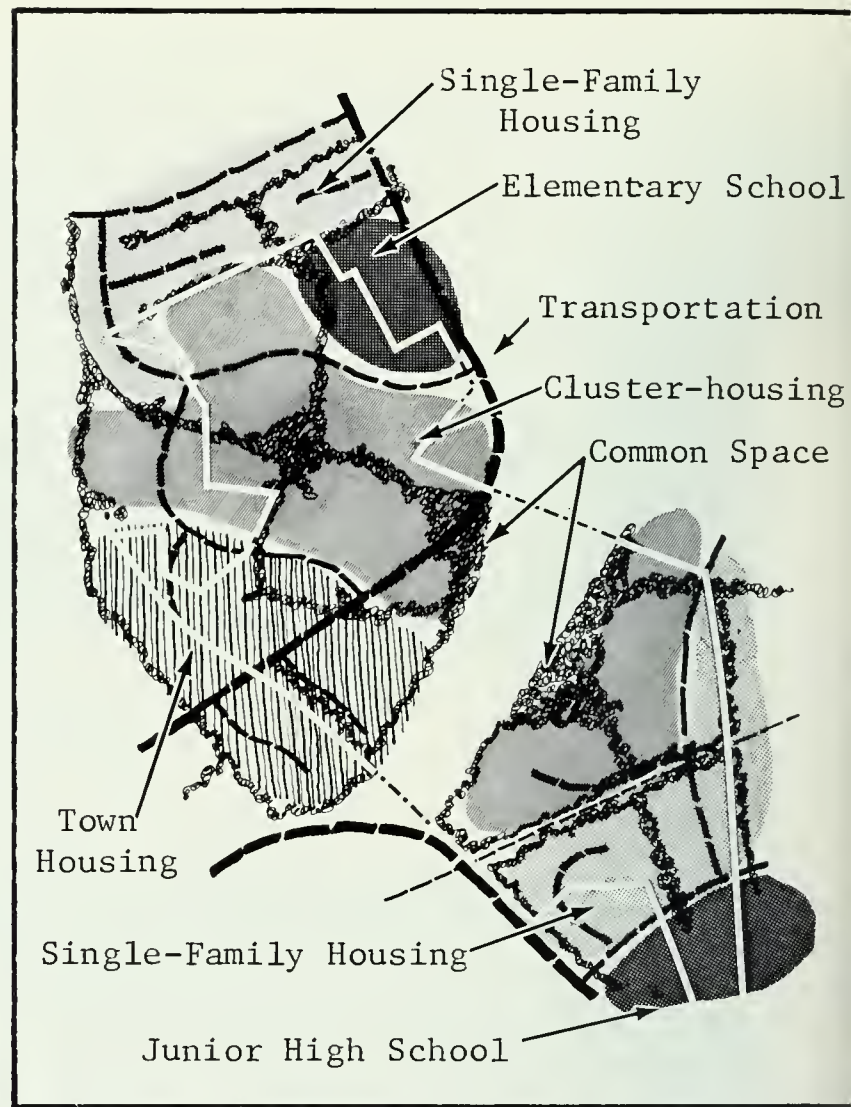
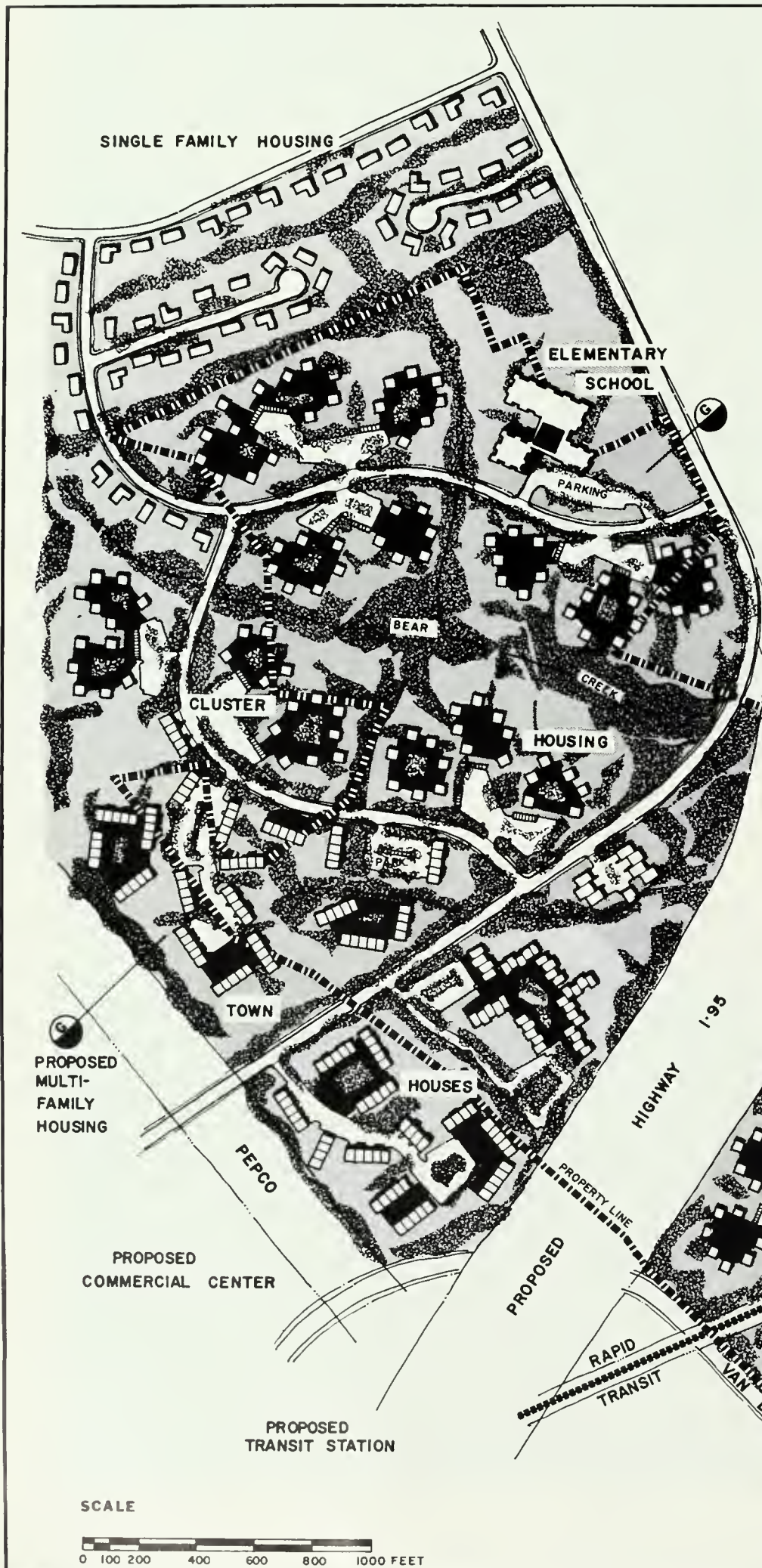


Figure 36(A) – The Concept

Figure 36(B) – Preliminary Development Plan "A"





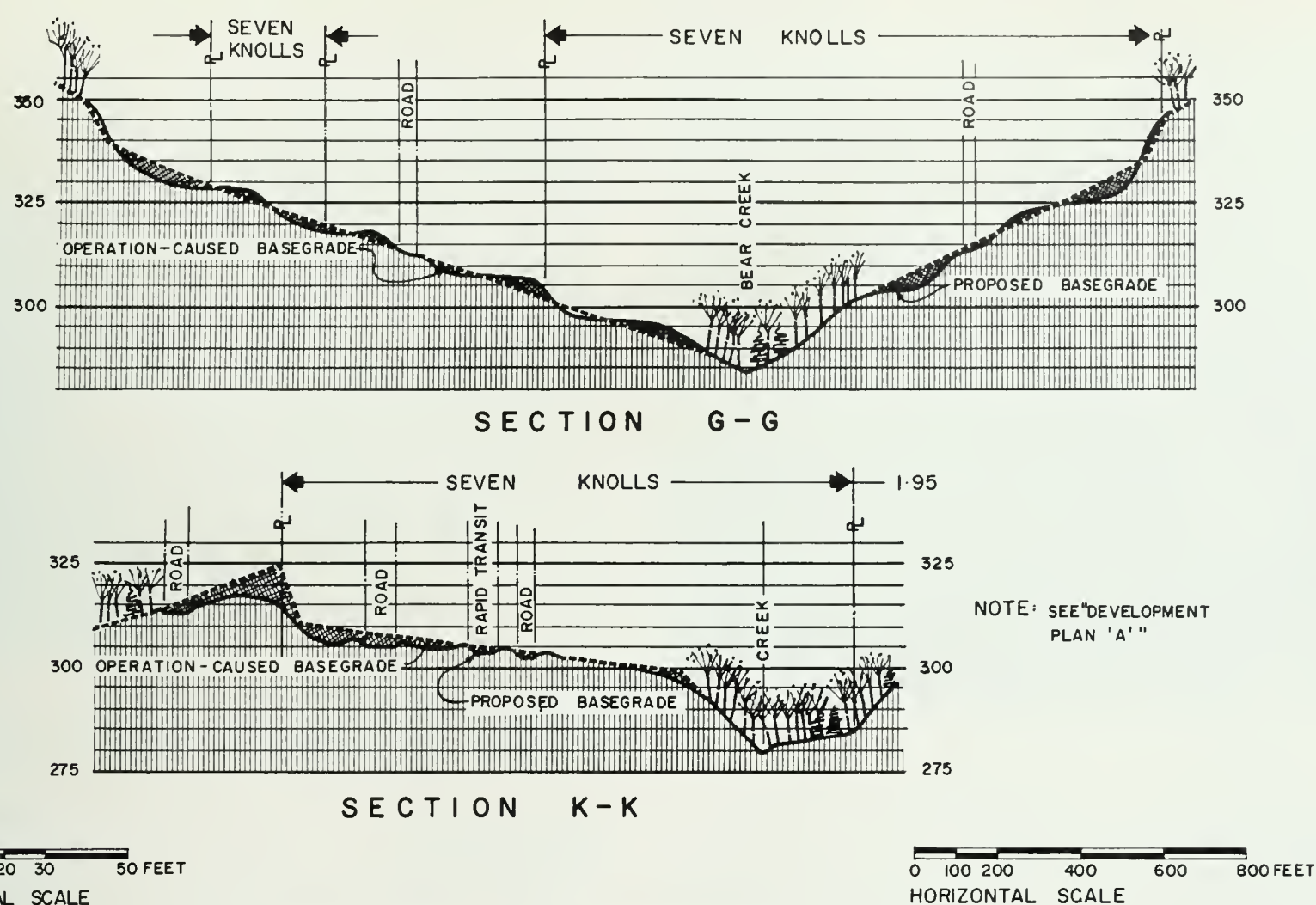


Figure 36(C)

A producer planning re-use of his site for residences should be conscious of the need to provide an enduring and stable neighborhood, which will involve the following:

1. The planned unit location should be marketable with access to the major transportation routes. Such a development only partially completed is a deferred asset for the producer, the community, and the occupants.
2. The community facilities should be provided or available within reasonable distance of the site.
3. Recreational facilities should be readily available and portions of the site that are rugged or heavily wooded will be worth the cost as natural recreation preserves.
4. For low-cost housing, shopping facilities should be within easy walking distance, with off-street parking.
5. Schools and churches should be provided in a central location, with easy access from all parts of the site. For children, pedestrian-ways separated from vehicular traffic with underpasses are important.

## Residential

Since Seven Knolls occupies a position adjacent to a regional center and because of the variety with which the basegrade is suited, a portion of a planned unit

development is illustrated in Figure 36. Though not completely illustrating the complete planned unit concept, the site and location seem well suited for this development. Also bordering Seven Knolls are proposed multi-family units, a commercial development, single-family housing, and a junior high school. Within the site, varying housing types such as town housing, cluster housing with varying unit combinations, and an elementary school add to the variety for which this site is suited. Preservation of the existing ravines (Fig. 37) and provision for a permanent active open space adjoining and common to all units will offer unity and variety to the development. While different housing offers varied architecture, the variable density of the cluster unit will further offer flexibility to this preliminary design (Fig. 38). The producer may see from the lack of facilities in adjacent subdivisions that the best use of his land will be for recreation, shopping, or community facilities. In this case the best use of the land and best service to the community will be met.

This is especially true when a lake, caused by operations in an area lacking recreational facilities, would serve best for recreation rather than being surrounded by a few choice lots. In many cases, developers attempt to reserve a few choice sites around outstanding physical features of the site, greatly limiting use of the feature.

Basically, successful land development for any of the three developments requires the provision of livable facilities to meet the need of those who will occupy the units.





**Figure 37 — Bear Creek Character**

## Land Subdivision Types

The pattern of a housing layout, including the type of house and street arrangement, will largely be influenced by the location of the site. Given a location, the following items will affect the design:

1. The residential zoning (i.e., the maximum size of the lot, FHA mortgage, land use intensity rating, or density requirements).
2. The residential housing type (i.e., single-family, townhouses, apartments, etc. which have different lot or acreage needs).
3. The drainage pattern of the site (i.e., the effect of drainage on the siting and road layout for drainage).
4. The road pattern (a functional street system is derived from the lay of the land and affords opportunities for the preservation and use of existing natural features).
5. The ability of operations to create buildable land.
6. Presence of natural features (i.e., finding the pattern around a lake, to make best use of the water).
7. Site size and shape (i.e., irregular boundaries or small sites will be limited in the flexibility of development pattern).
8. Economics of developing the site (amount of land leveling, added costs for construction fills, etc.).
9. Needs of the people who will occupy the site, generally influenced by income groups.

The typical land-subdivision patterns that may be used on a depleted site which depend on the physical character of the site are curvilinear, cluster for single-family and townhouses, the loop street system, and the cul-de-sac.



**Figure 38 — Single-Family Two-Story Cluster Homes**

## Curvilinear

First introduced in 1869 by Frederick Law Olmstead to replace the traditional rectilinear "gridiron" street plan, the curvilinear or free-flowing system eliminated the monotonous pattern which was exclusively used in the American landscape. The conflicts with hilly terrain, the through traffic, and the many conflict points of intersection were eliminated which were common to gridiron plans.

The curvilinear pattern introduced a functional street system which differentiated between kinds of traffic and eliminated the sixteen conflict points at four-way intersections. Short, land-consuming blocks (400 feet) were displaced by much longer, more continuous blocks (maximum 1200 feet) (Fig. 39).

The weakness of the curvilinear system was the allotment of open space plus the uneconomical roads and utilities. The curvilinear evolved into the diversified and functional systems of the cluster concept for residential development.

## Cluster Development

Best suited for irregular terrain in which housing can be grouped on buildable and advantageous areas, this concept appeared strongly in the 1950's as part of the suburban landscape (Figures 36 and 38). It not only benefits the cities with opportunities to connect separate open spaces, but allows individual developments to be better places in which to live.

The cluster concept is an old one in which most of the land generally used in the conventional subdivision for backyard and alleys is devoted to common open space. This is either dedicated to public use, or is limited to private group purposes and is then governed by some type of public, condominium, or home ownership management.





**Figure 39(A) — Curvilinear Pattern Proposed to Extend Into Excavated Sand and Gravel Site**

For the irregular basegrade of the depleted sand and gravel site, the cluster concept of land subdivision simplifies adaptation. For example, the cluster of homes in Figure 38 will require less grading than the adjacent area containing single-family homes. In this case, the producer can more economically adapt his site while providing more interesting natural recreation areas than if the whole site were devoted to one of the previous land-subdivision types.

In the cluster method for developing new residential areas, large open space and recreational areas are obtained by tightly grouping houses in some sectors of the property, thus preserving other portions for the benefit of the development. Smaller lots provide attractive open space which can be used in the following manner:

1. For schools and community activities.
2. For playgrounds and tot-lots.
3. For parks and sitting areas.
4. For emphasis and the setting of natural physical features such as lakes, wooded areas, drainage areas, etc.

In addition to the advantages listed above, the cluster type of planned-unit development benefits the home buyer in four ways:

- 1.. Lower-priced homes through more efficient land planning, with length of roads and utilities lessened.
2. Pedestrian traffic separated from vehicular traffic, increasing the safety and satisfaction of the development.
3. Small private yards for outdoor living with minimum maintenance.
4. Neighborhood recreation center for swimming, crafts, meetings, and other group activities at nominal expense through shared costs.

Though not recognized by all municipalities as an adequate subdivision type, because of the need for dedication of the open space to the city or as private units which may not operate efficiently, cluster design can function effectively. The maintenance burden for the city can be eliminated by establishing a homeowners association to manage and maintain the open space areas. To insure satisfactory operation of such an association, William H. Whyte<sup>4</sup> has offered six essential principles:

1. The association must exist before the sale of properties, so that each homeowner has an equal voice in decisions and control.
2. The membership is compulsory for the life of the development.
3. Any restrictions on the open space must be permanent.
4. The association is responsible for insurance, taxes, and maintenance of all facilities in the open space.
5. The home buyer must pay a share of upkeep for the open space, generally based on lot size or family size.
6. The association can adjust the home owner's shares of upkeep costs to meet the changing needs.

The objective is not to indicate that the cluster type of development is the only answer to housing for depleted sites, but to indicate its advantages. Some such advantages are as follows: (1) a means for disposing of sections of property that may be rugged and not suited for building sites but are appropriate for open space needs, (2) placement of hilly portions or lakes in an association for proper upkeep and management, (3) an attractive development, (4) good allotment on common space, and (5) more economic services.





**Figure 39(B) — Finish Grading and Construction of Single-Family Residences**

### Physical Requirements for Residential Subdivisions

Requirements can be classified into the following: (1) the condition of the depleted site including drainage and slope, (2) the street pattern, (3) the soil types, and (4) the quality construction of fill areas.

#### Condition of the Depleted Site

The most economical site for development (though not the most interesting) is a tract of slightly sloping ground with natural drainage outlets. Experience shows that utilization of flat land involves many difficulties that are costly to overcome, such as inadequate surface runoff which results in a high water table, adversely affecting house foundations, basements, pavements, and individual water supply and sewage disposal systems. Flat land usually requires extra grading to obtain adequate street gradients for surface drainage and lengthy collection mains for storm water disposal. Rugged or highly irregular land, usually needs an excessive amount of grading, while hilly land steeper than 8 to 10 per cent involves initial costs prohibitive for all purposes except the exclusive hillside residential market (Fig. 40).

Sites with irregular boundaries and easements usually mean excessive non-buildable areas resulting in uneconomical street and lot layout. Consideration should be given to the purchase of adjacent property for supplementary development and to simplify irregular boundaries.

#### Street Patterns

Regardless of the type of streets, whether curvilinear, cul-de-sac, or loop, certain streets should be designed for a specific traffic load and purpose: Local streets provide access to schools, homes, and business; collector streets are used to gather and distribute traffic from local streets, while arterial streets provide access from one area of the city to another.

Minimum grades for streets occurring on sand and gravel sites are required to insure adequate drainage. Because of the local variations in weather and road surface types, maximum grade limits are not listed here; however, regulations in each locality take into account

the topography and weather and can be obtained from city or county planning authorities.

A functional street system for a land-subdivision is derived from the lay of the land. Instead of natural features being removed because they interfere with a street system, they should be incorporated into the plan. A functional approach affords opportunities for the preservation and exploitation of existing site features. Esthetically, roads that follow the natural terrain as much as possible with a minimum of excavating should be encouraged. The beauty of the site thus enhanced is more pleasing to the eye when viewed from a distance.

Pit operations that leave steep basegrades present special problems for road layout and deserve special consideration. Economy of construction must be combined with safety, convenience, and the least amount of basegrade change while considering the quality soils for use.

#### Subsurface Characteristics

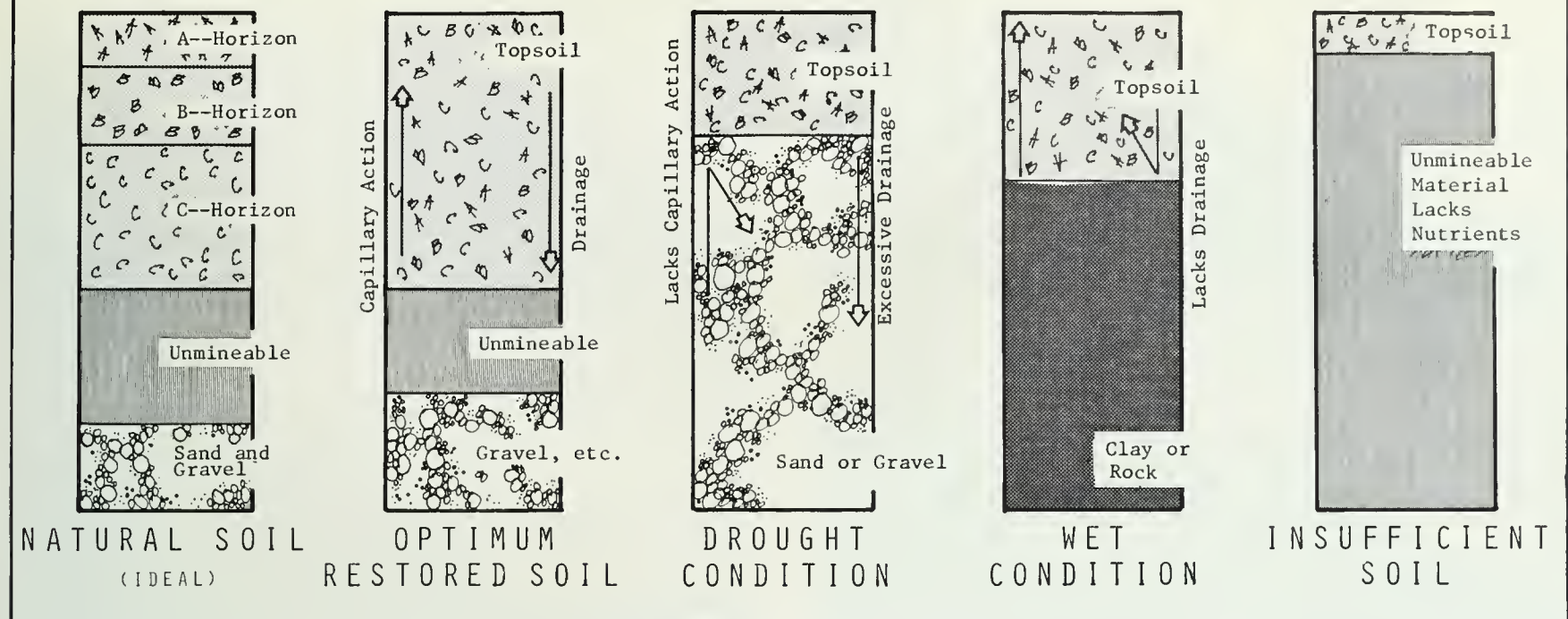
For residential use, knowledge of soils occurring on sand and gravel sites will involve the following: the soil types, load-bearing quality, compaction qualities, nutrient availability in topsoil, hydrologic conditions, and sewage-disposal potential.

Slope per cent	Type of slope	Character of land	Potential use
0- 2	level	level	Housing—streets
3- 7	gently sloping	undulating	Housing—streets
7-15	sloping	rolling	Hillside development and limited streets
15-25	moderately steep	hilly	Limited housing—recreation trails
25 plus	steep	steep	Erosion control planting and short trails

\* Federal Housing Administration, *Evaluation of Soils and Use of Soil Surveys for Engineering Purposes in Urban Development*, FHA No. 723, October, 1963, Washington, D. C., p. 7.

**Figure 40 — Use Limitations of Basegrade Slopes That May Occur on Sand and Gravel Sites\***





**Figure 41 – Soil Conditions**

Before the creation of a fill area, the subsoil or bedrock should be studied for stability. Sands and gravels are generally best for a base, because of their stability and good drainage. Fine sand or sand-silt mixtures may become “quick” when wet. For the average residence, it has been found that each two feet of fill depth beneath the house weighs roughly as much as the house itself. So, for deep fills, the weight of the residence is only a small percentage of the total weight of the fill on the subsoil and bedrock.

Topsoil is important for all re-use potentials, especially residences. Preservation and careful stock-piling of topsoil during the stripping operation is important to insure material for dressing the basegrade after mining is completed. Topsoil stock-piled or used for berms may loose the soil organisms when piled deep and for long periods of time. Mechanical stock-piling and re-distribution may overcompact the soil, eliminating the oxygen in the soil necessary for plant growth. Regard-

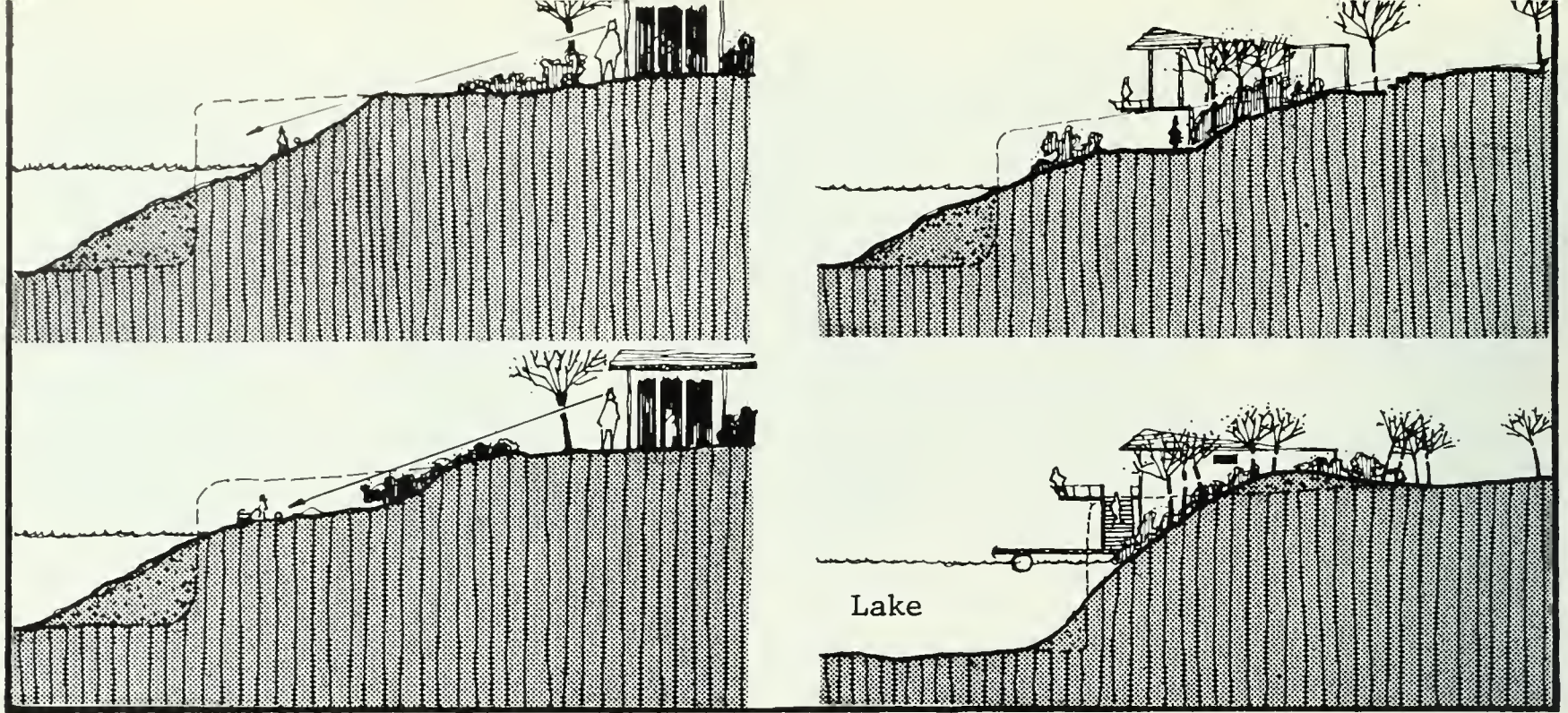
less of the loss of soil organisms and oxygen, topsoil should be retained on a site unless it is less expensive to haul in after operations cease. Also, nutrients in the preserved soil, that have taken centuries to build up and are therefore worth preserving, will be available (Fig. 35).

Analysis of hydrologic conditions of soils will be important. First, the water content of soils will influence the stability of the site for development, and second, the water table will affect the character of the final development by forming lakes and springs. Where peninsulas project into lakes, care should be taken to insure that the buildable land be at least five feet above the high water (Fig. 41). On the cutbanks, provisions should be made to control any springs caused by the operations. In the case of extensive fills, precautions should be taken to insure that excess material will not be deposited to interfere with the flow of underground water which may cause adverse rise or drops in the level of the water table.



**Figure 41(A) Cutbank Development**





**Figure 41(B) — Cutbank Development on a Lake**

### Summary

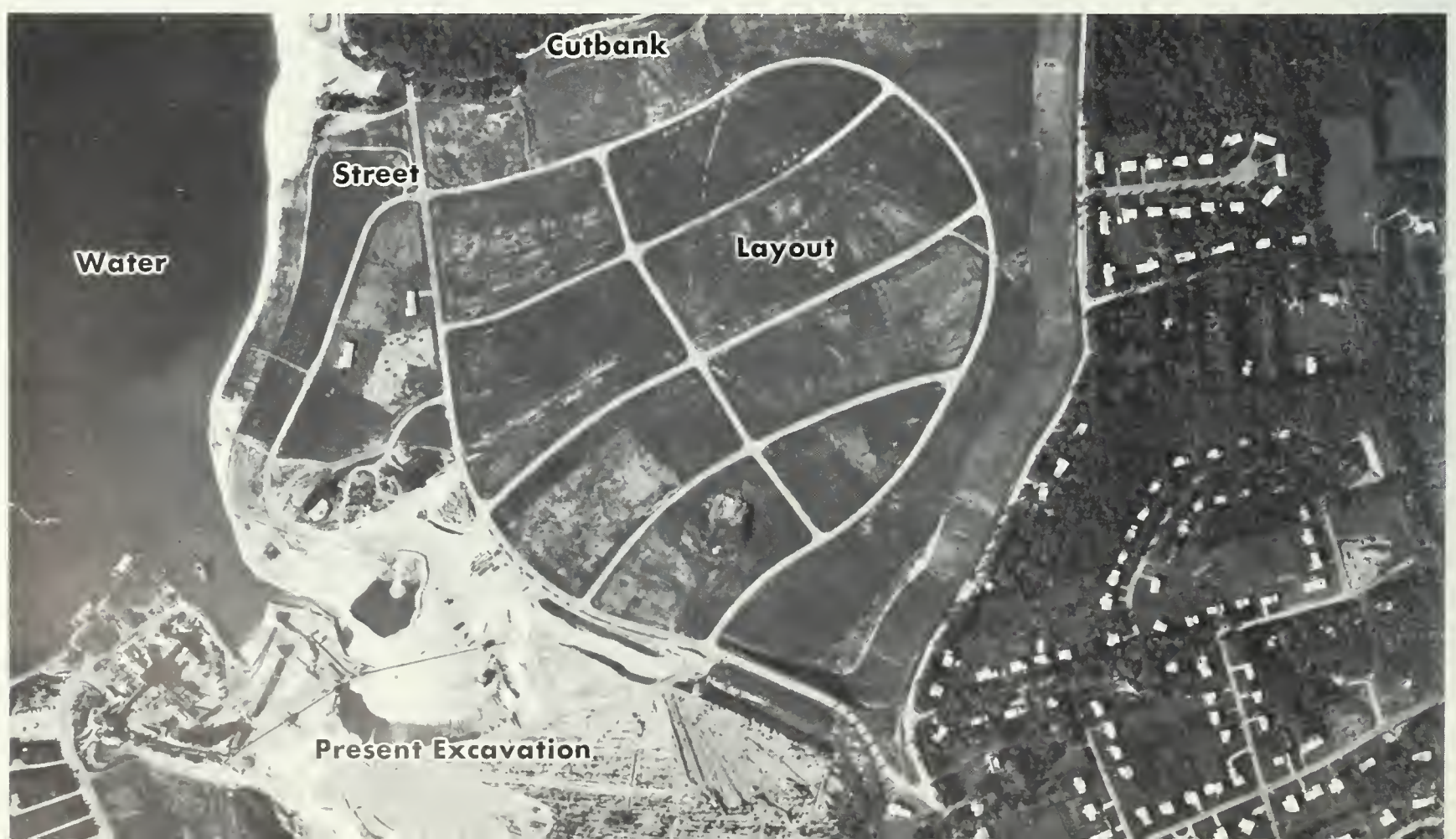
A depleted sand and gravel site can be adapted effectively to meet the esthetic and functional requirements of planned residential development through coordination and preparation of a master plan for the operations in collaboration with municipal, county, or township authorities (Fig. 42). Residential development should take into consideration nearness to the city and community facilities, the topography of the operations, soils and drainage, shape of the site and location, flooding, and climate. Services such as utilities, fire and police protection, garbage and waste disposal and influences such as airports, neighbors, and tra-

ditions of the community are all important.

A depleted sand and gravel site may have many soil groups both in the disturbed and undisturbed condition. These should therefore be studied for the most effective handling.

Residential development can occur on any of the soil types present in sand and gravel sites, though care should be taken to plan residences on the more stable soil areas for economical construction. Fills that occur should be carefully designed and closely controlled during construction to insure their immediate use. Fills that occur without engineering supervision may be questionable building areas.

**Figure 42 — A Planned Residential Development on a Dry Site**



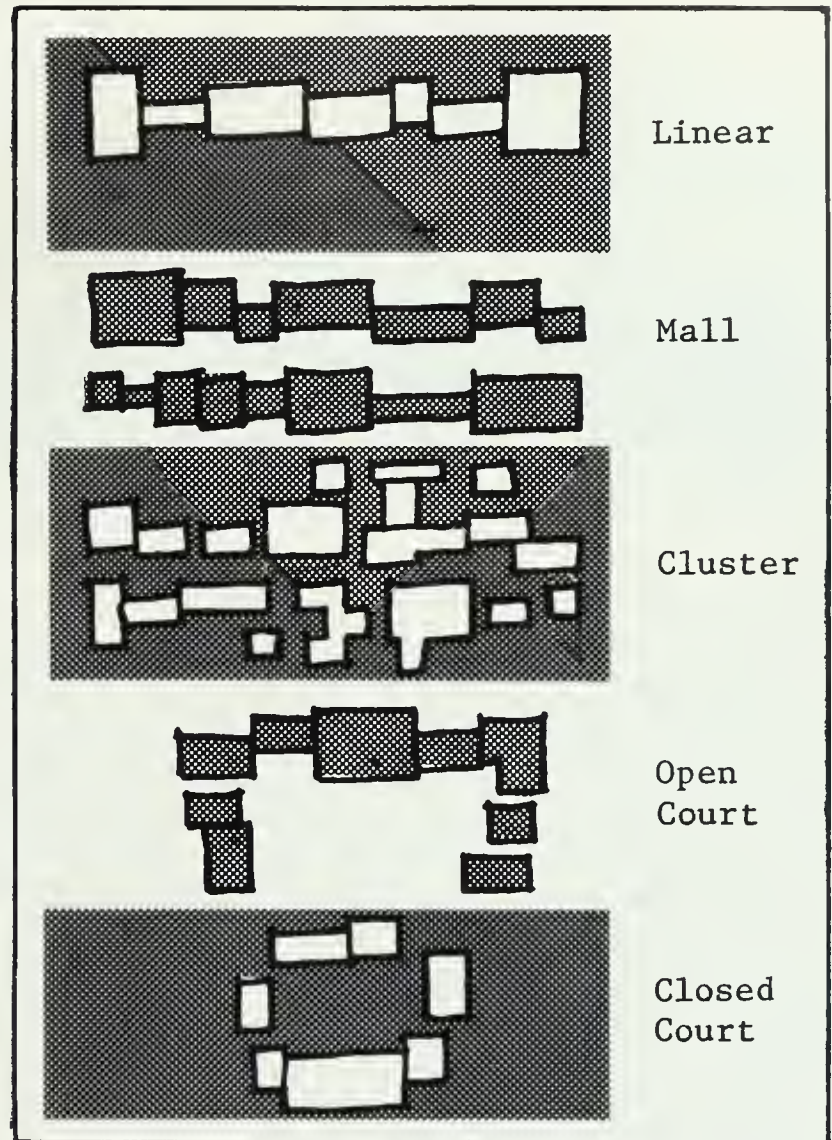


## SECTION 2

# Commercial Development: Shopping Centers

Associated with the other potential uses of depleted sand and gravel sites will be the need for commercial development to serve on-site and surrounding residential needs. This final use may include small "corner stores" dealing in groceries, drugs, and miscellaneous needs, which serve the immediate neighborhood. Larger units would include branch furniture stores and large food markets which can exist without attraction-support of other stores. Largest are regional shopping centers, which are predesigned clusters of stores providing a wide range of goods and services to fill the major needs of the suburban community.

Historically, the emergence of regional shopping centers as a major element in the commercial pattern of a region, second only to the central business district, has kept pace with population migration into outlying areas. The motivating force has been the pursuit of business opportunity offered in the suburbs. In their concentrated efforts to bring goods and services to the customers, commercial enterprises have oriented their business operations to neighborhoods of varying sizes,



**Figure 43 — Shopping Center Concepts for Varying Site and Community Conditions**



**Figure 44 — The Community Center**





**Figure 45 — A Regional Center Developed on a Sand and Gravel Site. Note Cutbank in Background.**

thereby providing neighborhood, community, and regional size centers.

Sand and gravel sites located in the suburbs have excellent promise for commercial development, because of the expanding residential development in these areas and the potential of such sites for bearing large buildings and parking areas. Such a dual-role function of land suited for mining requires knowledge of the following: (1) the major types of commercial land use, (2) the location-stability of sites for commercial development, and (3) the physical conditions required for commercial development to occur on sand and gravel sites.

### **Commercial Land Use Types**

Two major classes of commercial land use can feasibly locate in suburbs: (1) retail trade including personal, and business services such as pedestrian-oriented shopping centers; automobile-oriented self-generative business such as drive-in movies, drive-in restaurants and car dealers, and the business offices, branch banks, and clinics; and (2) heavy commercial suppliers, including lumber yards and farm equipment dealers<sup>5</sup>. For the purpose of this study this section will be oriented to illustrate the adaption of the pedestrian-oriented shopping centers.

Inherent with the development in suburbs will be the need of areas used for shopping facilities. Largely depending on the size of planned community, the scale and design of shopping facilities will vary to suit the trade area and site conditions (Fig. 43).

Shopping centers used here as examples of commercial development are a predesigned cluster of stores providing a wide range of goods and services for convenience and comparison shopping in suburban communities. Outlying shopping facilities have evolved from the efforts of supermarkets to establish neighborhood centers in the 1920's and 1930's. After World War II, the highly developed regional centers were attempted<sup>6</sup>. Today a complex operation requiring the combined services of many specialists, including landscape architects, engineers, architects, and merchandising experts produce such centers. The following is a summary of the three shopping center types:

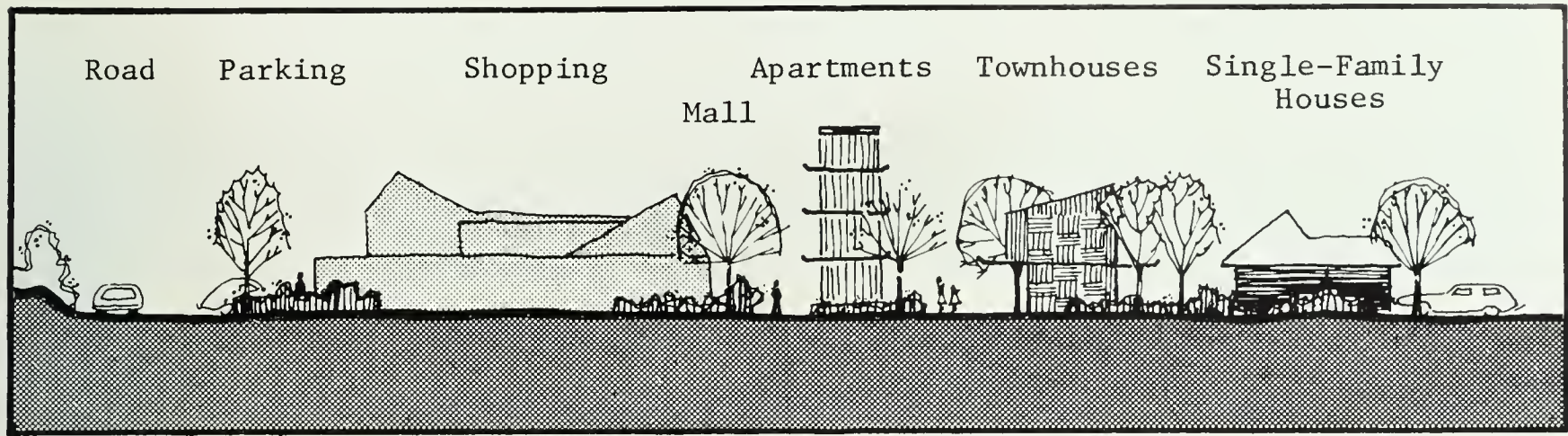
1. *Neighborhood Center.* This is the smallest, dealing in groceries, drugs, and personal services such as a beauty parlor. It is characterized by a relatively small trading area, a population of 3,000 to 5,000 a varying size from 4 to 15 acres and is within a 10 minute drive of 6 to 16 stores with a supermarket as the principal tenant.
2. *Community Center.* It is characterized by a junior department or variety store as the leading tenant plus 15 to 35 others and occupies from 10 to 30 acres. The potential trade area is generally within 10 to 20 minutes driving time and serves 15,000 to 30,000 people. This center is generally located at the intersection of two arterial streets or the intersection of an arterial and collector street (Fig. 44).
3. *Regional Center.* This type of development is the suburban equivalent of downtown areas. It is characterized by one or more major department stores plus 50 to 150 others. The site, generally occupying 30 or more acres, is located at the intersection of major traffic arterials within 15 to 30 minutes of the trading area. It serves more than 100,000 persons with a complete line of shops, store types, entertainment facilities, and branch business and financial service (Fig. 45).

### **Location of Shopping Centers**

The selection of a site for commercial facilities will not be concluded until the location of and access to a sand and gravel site have met the following recommendations.

The site should be located near a well-populated residential area or one that is growing and gives promise. Because most shopping is done by the home-bound shopper, the regional site should preferably be located on the right side of the out-bound route from the city. In neighborhood centers, however, the site should be located on the city side of the development. Walking distance will be important where high-density, multi-family housing is a part of the development plan and in some instances, high-density housing may be used as a buffer between the center and lower-density housing types (Fig. 46).





**Figure 46 — Proximity to Shopping**

When a center is justified in new developments, it should be near the main thoroughfare to the subdivision and with interior streets leading to the shopping center. In the satellite or large planned-community development where several centers of varying sizes will be planned, the largest centers will be centrally located with easy access from all parts of the development while the smaller types will be readily accessible only to the immediate trading area.

Access, either by auto or pedestrian means, should be easy and convenient and where possible, separation of the two types is important through horizontal or vertical means. From the access routes previously mentioned, it is desirable that free-flowing traffic reach the site through right or left turns without congestion. Entrances to the site must be well away from intersections and high speed traffic; centers should not require that traffic filter through neighboring residential streets. A sand and gravel site proposed for a center should be accessible from at least one, but still better, from two major highways. Finally, if the choice is available, regional centers should be accessible from radial or circumferential highways that connect with the urbanized residential suburbs of the city<sup>7</sup>.

### **Physical Requirements of Shopping Centers**

Natural conditions which will affect selection of a site for a shopping center will be the shape of property,

the size of the property, the topography, the soil load-bearing capacity, and site visibility.

The site should be regularly shaped without odd angles and projections into and out of the site. Portions of irregular shaped sites may result as unusable land, forced design, and costly solutions. The depth of the site from the major road should be 400 feet or more to accommodate parking, the buildings, services, and permit a good view of the development (Fig. 47).

Next, a center will need sufficient property for buildings, parking, buffer areas for separating the center from adjacent development, and expansion potential to satisfy future needs. The Urban Land Institute indicated that a community center having 150,000 square feet of building requires a 15 acre site, while the regional center with 400,000 square feet of building needs a 40 acre site<sup>8</sup>. Other typical factors might be as follows:

1. A minimum lot size of one-half acre for an individual commercial facility.
2. A maximum building coverage of 30 per cent to allow space for parking, services, buffers, and off-street loading docks.
3. A minimum setback of 50 feet for buildings from roads.

Thirdly, a gently sloping site (one to two per cent) is best for shopping center locations. Steeper slopes can offer interesting designs, but use of a two-level arrangement poses planning problems in access, circulation,

**Figure 47(A) — A Shopping Center Site During Excavation**







**Figure 47(B) — And the Same Site During Final Site Preparation and Building Construction**

and location of store types. On a more rugged site, parking can be screened from view, but for advertising purposes it is important that attractive buildings with pleasant compositions of plant materials be observable from major roads.

As to slope, five per cent should be maximum because of the expensive need to step large buildings on a higher slope. It is important that, before accepting this rule, examination should be made of a scheme to use steeper sloping sites. In some instances, the higher slopes may be advantageous for large two-level centers or the smaller one-level types.

As with other potential uses, the soil types and quality are important factors. The building area clearly calls for a higher soil-bearing capacity than does the adjacent parking, and a site analysis preceding excavation should be made to determine the quality of the basegrade after operations cease for the best location for buildings. Another factor of significance is the retention of enough topsoil for buffer and planting areas.

### **Summary**

Depleted sand and gravel sites can effectively be adapted to meet the esthetic and functional requirements of pedestrian-oriented shopping centers as well as automobile-oriented facilities such as banks, furniture stores, and restaurants. Three important principles govern whether a site should be used for such commercial developments: (1) Is there sufficient trading area or demand, (2) Is the location optimum for drawing proposed customers, and (3) Are the physiographic conditions acceptable for commercial development? The last question is the most important to the producer, because the physical condition of a depleted site may negate advantages such as location to major thoroughfare and a trading area.

The aims of a master plan should emphasize the interests of the community and future commercial development through simultaneous development of the site. Staging the excavation and exercising precise control over the basegrade to insure inexpensive final development costs for the buildings, site entrances, and parking areas will better insure a site for commercial use. A development of this type on a depleted site will then be valid and in the interests of the producer for deposition of his depleted site.

## **SECTION 3**

# **Institutional Development: Schools**

Implied in the development of suburbs are needs for institutional development, such as churches, schools, colleges, hospitals, universities, cultural centers, and related public service facilities such as sewage disposal plants and utility stations.

Schools are especially appropriate as typical examples of institutional development on depleted sand and gravel sites because of similar site and basegrade requirements. Expanding suburbs and large residential developments have potential for various size school sites, (such as the Community College planned for Seven Knolls) and producers with sites well situated for school development will be providing a beneficial use for the community.

Many new schools are using the campus, playground, or school park layouts for better integration into the community and natural conditions on the site (Fig. 48). For instance, in many communities, the school-park area will double as after-hours recreation space for both adults and young people. The school site will be designed to provide maximum site interest through utilizing topography, outstanding natural conditions, view, and location. Outdoor activities are increasing in both elementary and secondary levels, thus imposing new demands for large extensive school grounds.

A large site suitable for residential development can, for balance and completeness, include provisions for a school. Although final construction may be the responsibility of public authorities, a development plan for the site, including space for school needs will insure prospective home buyers that there will be adequate facilities. The presence of elementary schools is one of the most favorable drawing cards in residential development, because families with pre-school and school-age





**Figure 48 — A High School and Apartments Developed on an Excavated Site**

children form a substantial part of the prospective home-buying market<sup>9</sup>.

A sand and gravel operator considering possible use of his site, in part or as a whole for school purposes, should understand that the acceptance of a site by the school board will depend on several factors: (1) adequate size for buildings and activities; and a location advantage to education activities, (2) the function the school is to serve such as grade levels and relation to community activities, and (3) the physical site requirements to meet building and other school site functions.

### **School Site: Size and Location**

School grounds are required to meet the area requirements of outside activities along with the building area needs. Activities generally required, based on the purpose of the school site expressed by representative groups of school-plan specialists, indicate that the site should provide space and equipment for physical education, athletics, outdoor study of nature and conservation, outdoor assemblies, driver education, and exhibitions in music, dramatics, and art.

Added for some junior and senior high schools are provisions for agricultural programs and meeting places for youth clubs. Parking for both school staff and visitors, summer recreation, recreation facilities for children and adults, room for pleasant approaches to buildings, and areas for exhibits, picnics, and projects in gardening or other esthetic uses of plant materials for school and community beautification are additional needs<sup>10</sup>.

For the building itself and areas for outdoor activities, the following acreages are required:

1. Elementary Schools 5 acres minimum plus 1 additional acre per 100 students, with 10 to 25 acres preferred.
2. Junior High Schools 10 acres minimum plus 1 additional acre per 100 students, with 25 to 50 acres preferred.
3. Senior High Schools 20 acres minimum plus 1 additional acre per 100 students with 40 to 100 acres preferred<sup>11</sup>.

Though varying from community to community, the minimum site sizes then should be 5, 10, and 20 acres respectively for the school sites.

A site conducive to a happy, productive school atmosphere should be free of dust, noise, and physical hazards such as highways, railroads, and uncontrolled water bodies. Because of noise and safety, buildings should be situated a maximum distance possible from roads. Other uses, such as air fields, stores, taverns, and factories close to schools are objectionable distractions.

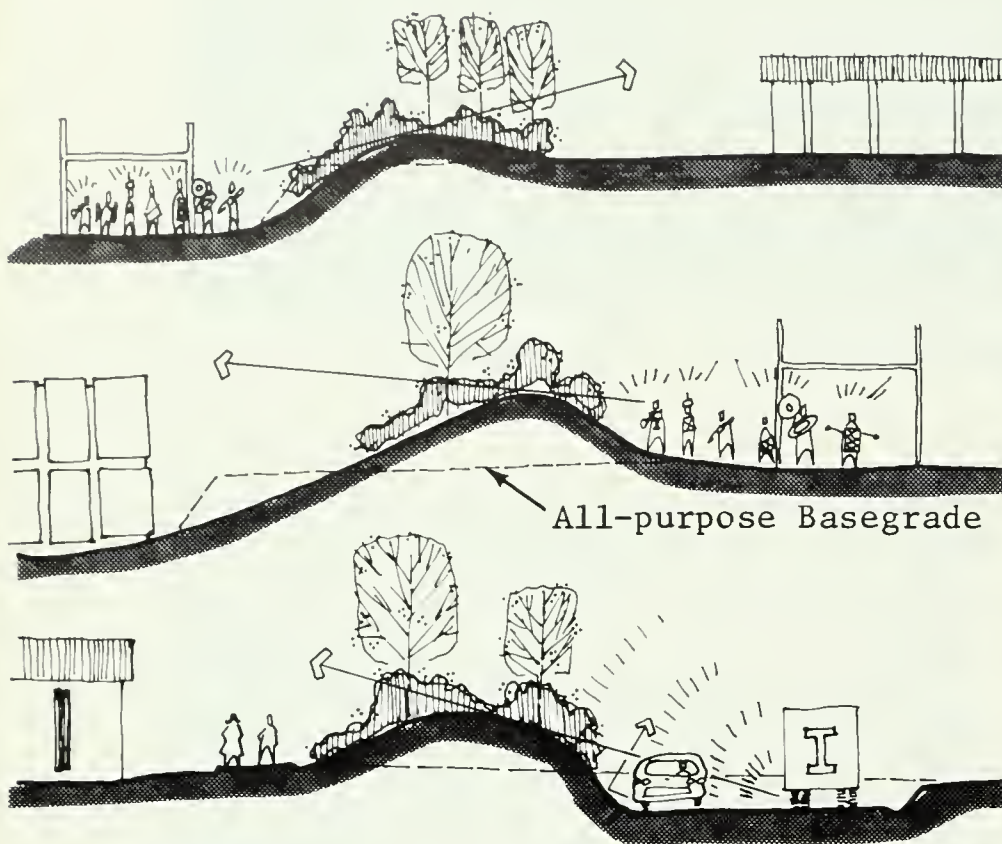
Within the school district, students should be able to walk from home and back free from having to cross automobile and truck traffic. This can be accomplished by providing overpasses or walkways separated from streets (Fig. 49). Recommended distances for students to walk are one-half to three-fourths miles for elementary schools, one to one and a half miles for junior high schools, and a half to two miles for high schools. These are major determinants for school development on a depleted site.

Other locational requirements for school sites are accessibility to water, sewers, electricity, and other utilities at reasonable cost.



**Figure 49 — Separation of Circulation Types**





**Figure 50 — Functional Uses of Earth Forms for Activity Separation**

### Physical Requirements of Schools

A well-treated school site located in a residential development can be a focal point for the area. The tradition of placing a school at a prominent point or high area in the community should be followed, instead of the old corner drugstore type where neither the design nor the setting is effective. Effort should be made to use the portion of the site with pleasant vistas and maximum sight-distance, plus interesting topography and a soil with the maximum load-bearing capacity.

As with most other land-use categories, school board officials will prefer a site that provides adequate drainage, gently sloping terrain, and a soil type which can readily carry the weight of the buildings. Also important will be a sand-loam topsoil which will support grass and other plants. To be usable as play and athletic recreation areas, the slopes must be naturally gentle or terraced. Sites which contain extensive and shallow bed-rock formations should be avoided because of the cost for blasting and excavation necessary in laying foundations and service lines.

In instances where basegrades after operations slope more than 4 to 5 per cent, the producer with school-use potential can still terrace the site and produce level areas required for buildings and outdoor activities.

In the course of terracing, the producer may actually find an increase in the amount of material available for mining, while also making the site more buildable. Providing tree and shrub screens and vertical separation during the mining operation in coordination with the master plan, will make the final school development

much more economical. Site interest and esthetics are also increased through provision of naturally undulating areas and screen mounds to avoid noise from adjacent automobile traffic, band practices, and athletic activities during school hours (Fig. 50).

Paralleling the proposals for this site by the Maryland Planning Commission, a Community College is demonstrated as a potential institutional use of Seven Knolls. In compliance with the analysis of the site (Chapter II), the design for the college takes advantage of desirable conditions such as level areas, the major creek environment, and locations of buildings to provide a more economical and esthetic development (Fig. 51). The college with a maximum enrollment of 3,000 commuting students and an evening adult education series with upwards to 6,000, demands great expanses of parking facilities well integrated into the site. Unlike the previous development residences, a scheme for a school or small college necessitates large terrace areas to accommodate the buildings, parking, and recreation areas.

### Summary

The sand and gravel producer proposing a school for final development will need to insure that his property can become an integral part of the total educational program for the community. The site will be examined by the school board in terms of how it can best and most efficiently provide the required spaces and satisfy basic criteria such as the following:

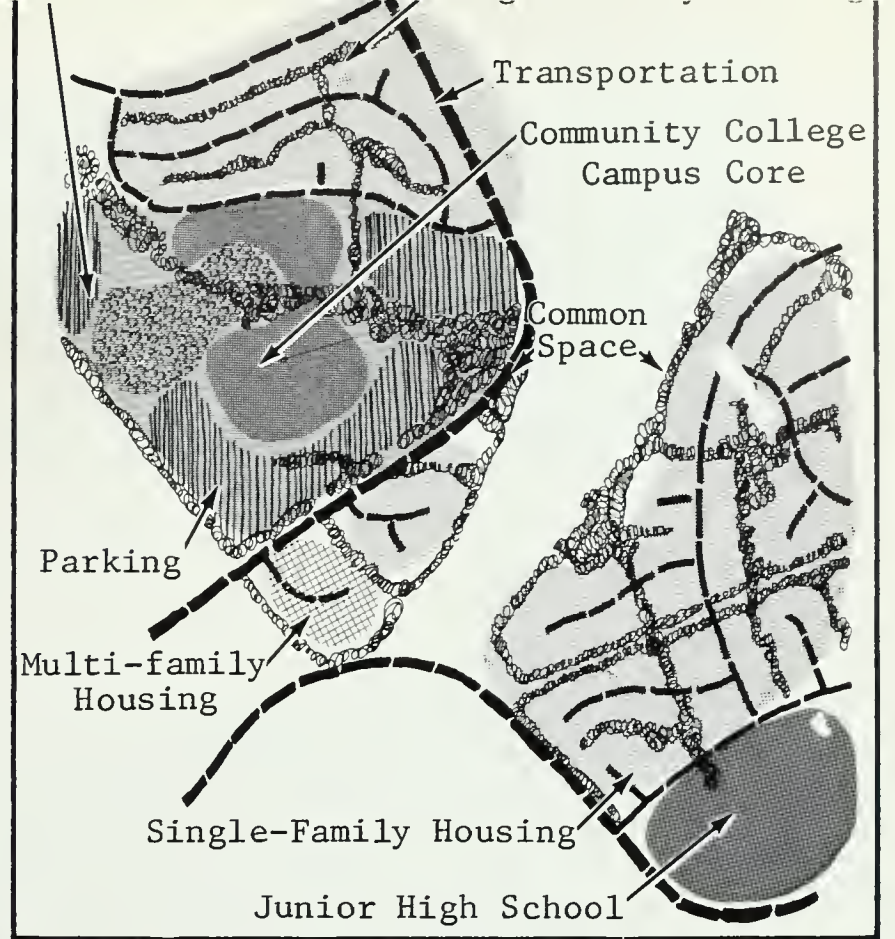
1. Is the site location to serve both the present and future school population?
2. Are the size and suitability of the site appropriate to accommodate the building needs and spaces for outdoor activities?
3. Are the physical features of the site acceptable to allow efficient adaptation and development at an economical cost?

The specific size of a school-park center will vary in terms of the following factors:

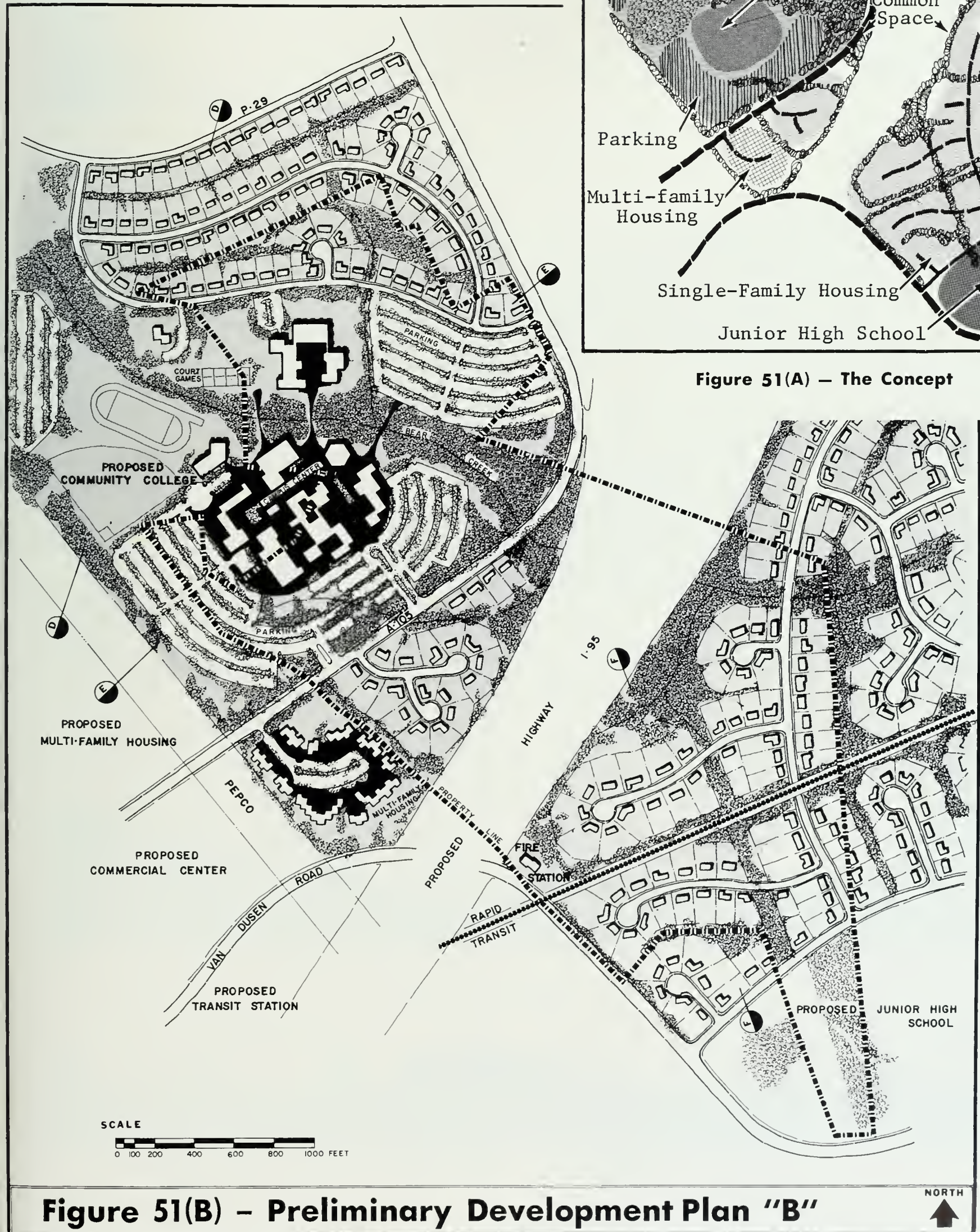
1. Availability of other public facilities for recreation.
2. Shape and topography of the site.
3. Density of population and predominant age groups of people the center is to serve.

School-parks can represent a wise potential use for sand and gravel sites. In addition, they can be a point of pride and a credit to the community where the producer cooperated in providing a desirable site. An acceptable site should include interesting topography and amenities such as native or artificially natural regions and screened areas at reasonable cost; thus providing a supreme environment for the children and adults of the community with advantages and features not possible on ordinary land.





**Figure 51(A) – The Concept**





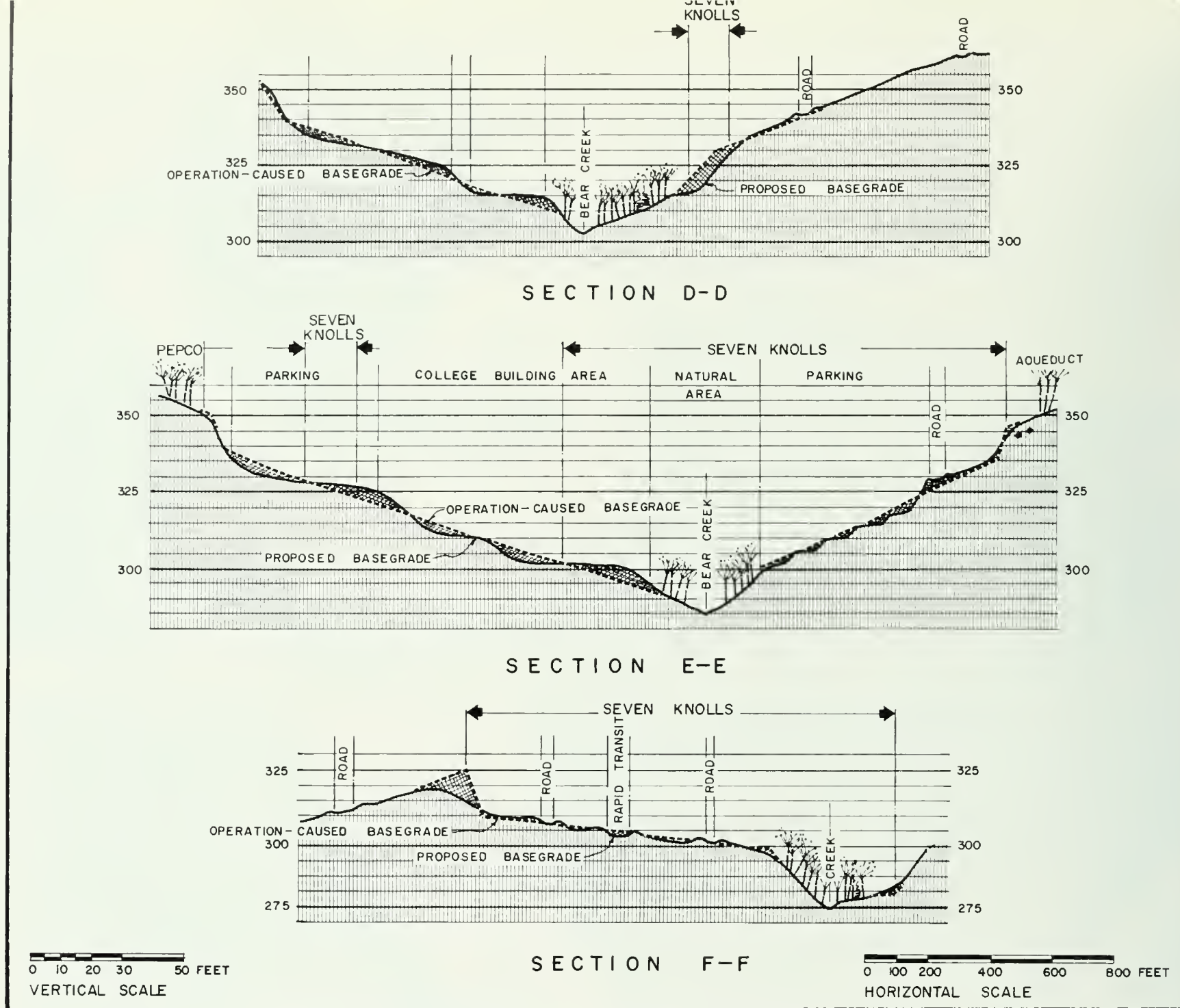


Figure 51(C)

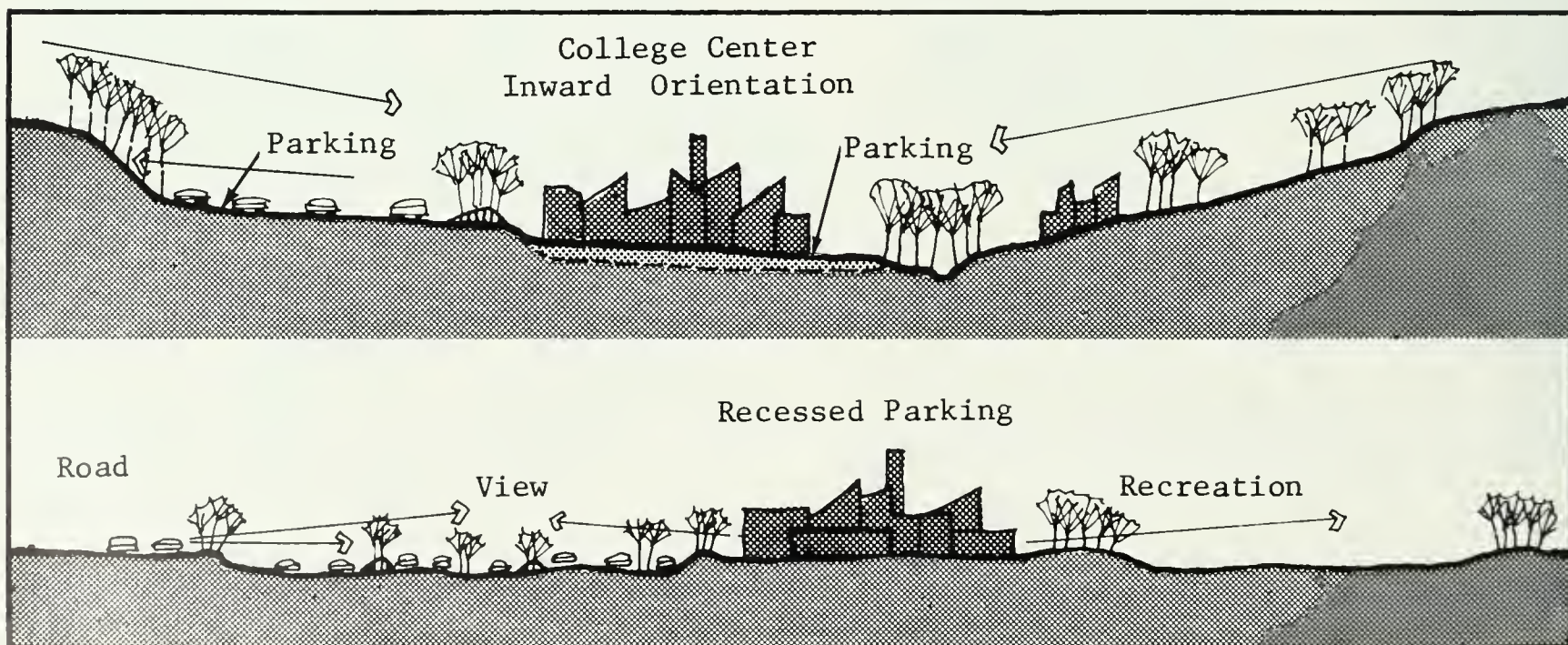


Figure 51(D) — The Character





**Figure 52 — An Entrance to an Industrial Complex**

## SECTION 4

# Industrial Development: Industrial Parks

This section contains background information to help the producer adapt his site for industrial development. The objective is to illustrate the excellent possibilities of converting sand and gravel sites for such development by consideration of the following points: (1) an understanding of the requirements for industrial development, (2) advantages to industry of depleted sites, and (3) an examination of the methods of preparing a site for industrial re-use.

Producers with experience develop their sites knowing that simultaneous excavation and development insures the most economical and successful re-use. Until recently, most industrial land improvement programs have been conducted by developers, who found depleted and derelict sand and gravel sites available at low cost. Producers understand now that developing their own land for re-use results in valuable property plus additional profit and prestige for their company.

Unlike residential developments using  $\frac{1}{3}$  to 1 acre lots, this section considers a land use requiring much larger acreages. For example, the Tri-County Planning Commission of Akron, Ohio, found industrial sites in that area varied from 1 to 250 acres. Provision for the large building sites then, must occur early in the extraction process to insure a successful and economical site development.

## Requirements For Industrial Park Development

### Background

Historically, industry has located near the intersection of major transportation routes, where workers built their homes and cities have evolved. Since the end of

World War II, however, industry has begun a shift from the cities to suburban areas and smaller surrounding communities. Here industry has located in districts that provide planned industrial sites plus the amenities to insure an esthetic environment.

The diversified requirements for districts, as defined below, will be the focus of this discussion. The fact that industrial districts are large and sand and gravel sites are of equal size makes the depleted site conducive to this type of development. Although many depleted sites will only be suited for one or two industries, rather than a full-scale park complex, it is felt that a discussion of the requirements for a district will be sufficient to cover the requirements of smaller sites.

Inherent in a district of large acreage is the need for compatibility between participating firms and the surrounding land uses; thus the industrial park concept has evolved. Embodied in the "park concept," in addition to the requirements for a district, are the esthetic qualities necessary for an attractive appearance (Fig. 52).

### Industrial Parks

The purpose of an industrial park is to provide a number of firms with comprehensive physical planning and an attractive environment. An industrial park might be defined as: an appropriately located area of land, subdivided and limited to industrial use with utilities available; plus such esthetics as good housekeeping, adequate planting, greater setbacks, and architectural building controls.

In a 1964 survey conducted by Conway Research, Inc.,<sup>12</sup> an attempt was made to determine the extent to which various sites meet the requirements for industrial parks. The national average of buildings-to-land ratio was found to be 52.4 per cent, with 60 per cent coverage occurring most frequently. The smallest site was 5 acres with about 50 per cent coverage, and the largest 30,000 acres with flexible coverage. A low land-coverage of 25 to 30 per cent is important to insure space for on-site services such as roads and utilities, as well as to maintain esthetic character typical of sites deserving the industrial park description.

A well-planned industrial park will meet the following criteria:<sup>13</sup>



1. Ready access to a major interstate or state highway.
2. Planned railroad sidings with access to railroad lines plus air and truck transportation.
3. Off-street employee parking space.
4. Off-street maneuvering space for trucks.
5. Off-street unloading docks and screened storage areas.
6. Water, sewer, gas, and electric services.
7. Adequate setbacks, ranging from 35 feet to 200 feet respectively from adjacent buildings and surrounding land uses; adequate lawns, trees, and shrubbery to give the park-like atmosphere.
8. Flexible lot sizes for development needs with adjacent space for expansion.
9. Adequate building-to-land ratio (25 to 30 per cent) to provide for an open space for the above facilities.

By careful planning, depleted sand and gravel sites can meet these requirements. One example of successful utilization is located near Needham, Massachusetts. Before development, the site was typical of many in that it was ungraded, with overburden, topsoil, and waste piles occurring frequently (Fig. 53A). Development plans were implemented to smooth the basegrade, spread the waste material into the depressions, and generally to adapt the site to a buildable condition. The multiple-value gains to the industrial developer, producer, and the community are clearly illustrated in Figure 53B.

### **Advantages For Industrial Park Development**

Sand and gravel sites offer certain unique advantages for industrial park development. Some of these advantages are as follows: large acreages, uncongested location, buildable soil, added land from fill areas, and potential for esthetic and functional uses of lakes and basegrades created by operations.

#### **Large Acreages**

According to the March 1964 issue of *Industrial Development*, as cited above, of 758 reporting industrial districts and parks, the smallest was 5 acres and the largest 30,000 acres, with an average of 300 acres.

In The National Sand and Gravel Association's Research Report No. 1, "Simultaneous Excavation and Rehabilitation of Sand and Gravel Sites," by Anthony M. Bauer, it was found that sand and gravel sites follow the same range as industry and may be as small as 10 acres and as large as 3,000. The survey also showed that sites in rural areas average 650 acres, while those nearer suburbs averaged about 250 acres. The following are some of the benefits of large sand and gravel sites for industry:

1. Simplicity of land acquisition. (For example, most depleted sites are under one owner, whereas procuring land from other sources may involve many landholders.)
2. Flexibility of development. (A large site allows a variety of lot sizes and road layouts in contrast to gridiron plans of present smaller developments.)
3. Acceptance of zoning obtained more readily for large sites as opposed to individual firms procuring it for smaller sites.
4. Economical installation of services. (The cost per firm is less than the cost to a firm on a small individual site.)

### **Uncongested Locations**

The larger acreages of sand and gravel sites generally occur in two types of locations: in completely rural areas, and on the edges or the path of, urban development. In most cases, the site is isolated and surrounding land uses have little influence on the final development. A large depleted site just outside suburban development would be advantageous because:

1. A more flexible design can be created for industry without limitations or harmful effects from surrounding land uses.
2. Good connections to the city are through routes already established by the sand and gravel producer.
3. Industrial zoning has already been or can readily be attained.
4. Land is less expensive than sites facing immediate urban encroachment, such as the suburban areas.

### **Buildable Soil**

Land in a suitable location for industry must be well-drained, and capable of supporting large and vibratory building-loads. With a few exceptions, any site with deposits suitable for sand and gravel extraction will be adequate after excavation for industrial purposes. (See Appendix).

### **Lake Developments**

Buildable land existing or acquired from fill areas adjacent to lakes will be beneficial for industrial development. Industry uses water in greater amounts than any other resource,<sup>15</sup> and will naturally be interested in sites with major water sources. Lakes can provide water in quantities equalled only by major groundwater deposits and, for industrial development serve two purposes: (1) as a source of water for processing and for fire protection, and less important uses such as cooling for air-conditioning, washing materials, and for sanitary services and (2) lakes also function as esthetic features when properly planned in shape and depth and serve as barriers against vandalism, transitions from surrounding land uses, and provide irrigation water for lawns and plantings. Lakes which occur from dredging operations

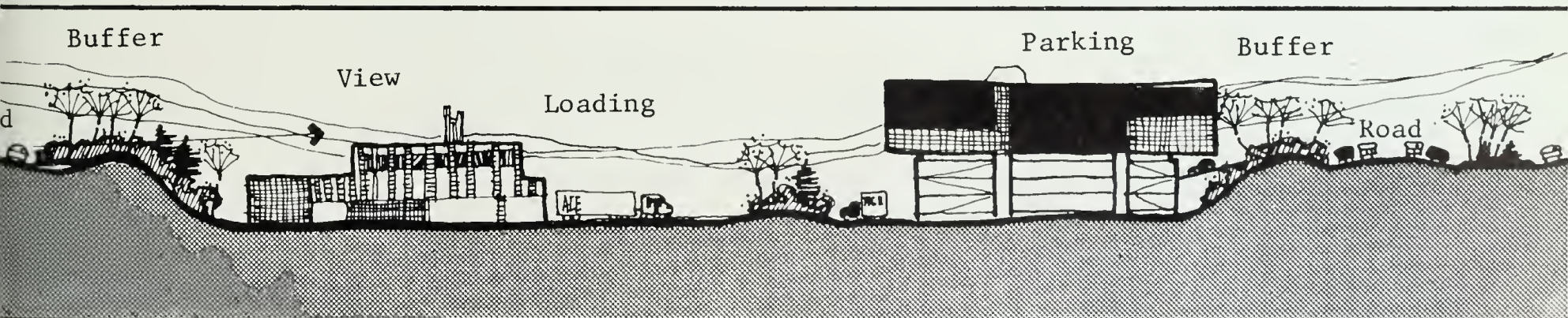




**Figure 53(A) — Before Development to an Industrial Center**

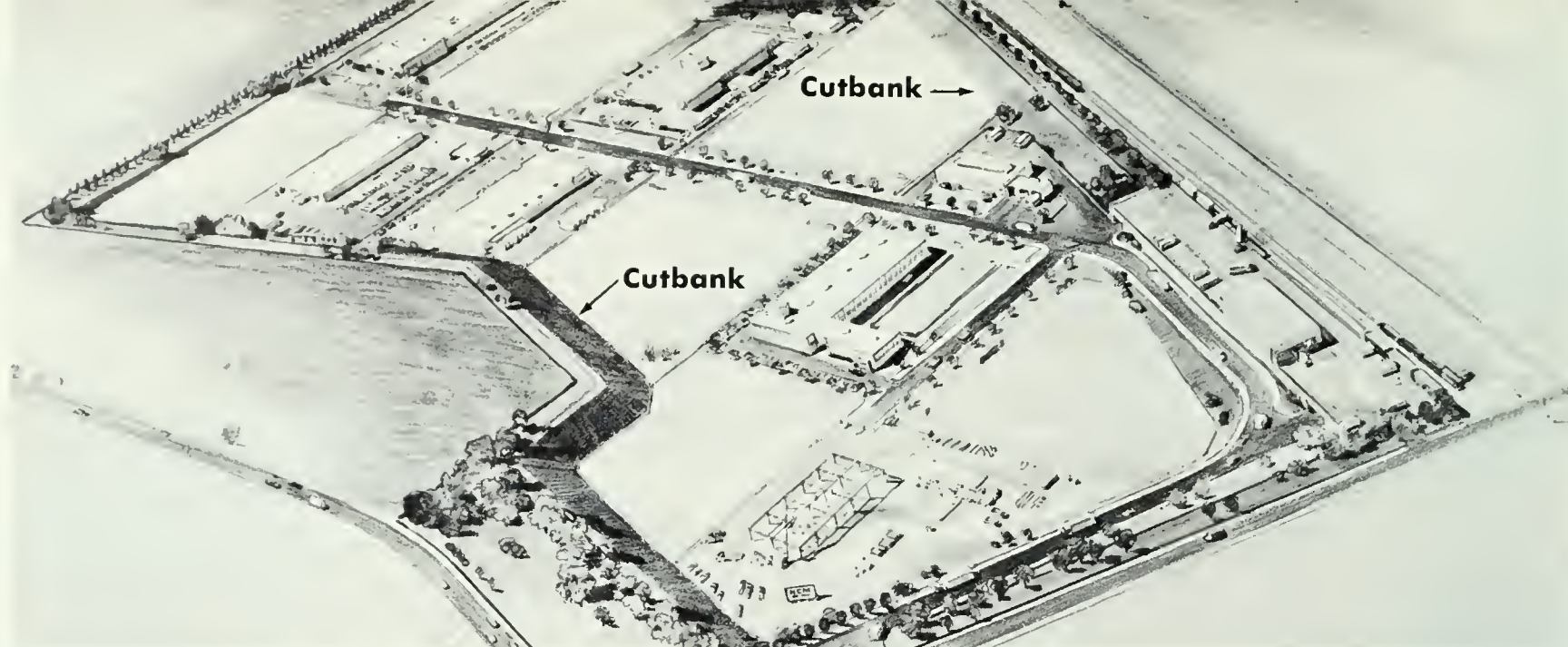


**Figure 53(B) — An Industrial Center Development on a Depleted Sand and Gravel Site<sup>14</sup>**



**Figure 54 — Industrial Use of the Below-Grade Excavation**





**Figure 55 — Industrial Park Planned for a Below-Grade Excavation<sup>16</sup>**

will be 20 to 35 feet deep. This depth provides adequate percolation of water from surrounding deposits to insure circulation of the water, and will help to keep the lake from stagnation and at a constant level.

To insure that operation-caused lakes will be an asset to the final development, the producer should examine the following points:

1. The location of the lake in relation to buildable land. (Proper planning before operations will insure that the lake becomes an important feature.)
2. The relationship of the lake with adjacent and on-site developments.
3. Any conflict in possible uses for the lake. (A water body used for waste absorption likely will not be suited as a site amenity. In most cases restrictions should be drawn for the use of the lake.)

Water supply for lakes caused by operations is generally from the surrounding glacial or fluvial deposits, and is usually adequate for industrial needs. In some instances, though, the water supply from areas of fine sediments such as glacial till, loams, or clay is rarely adequate unless supplemented at increased costs by drilling and pumping from the underlying aquiferous deposits. Hydrological studies of the site and deposit should be made before planning for industrial park development.

### **The Adaptation of Sand and Gravel Sites For Industrial Park Use**

In addition to the requirements already discussed, the producer should be concerned with certain on-site features which will convert his site for industrial use. Some of these features are as follows: (1) the need for adequate space for buildings, (2) level land, and (3) flood protection for sites located in or adjoining the floodplain of streams or rivers (see Appendix).

### **Providing Adequate Space**

Industrial firms within a park will require large level spaces for buildings and services. As an example, a building of 8,000 square feet may need up to 16,000 square feet additional space for employee parking, plus service roads, unloading, and outside storage. Where terraces have been used to raise or level land for buildable space within the park, the non-buildable areas can often be used to fulfill open-space requirements. In some instances, where sand and gravel extraction may produce an irregular basegrade, advance knowledge of the level space needs can be secured by consultation with an industrial expert familiar with the character of the industry likely to locate in a particular region.

Consideration should be given to possible use of excavations below ground level (Fig. 54). A basegrade less than 30 feet deep can be advantageous to hide objectionable industries. Pit bottoms deeper than 30 feet may be out of character for industrial development and in most cases below the water table. The presence of a large open space of more than 50 acres, plus an esthetic planting treatment of surrounding slopes, should generally make depressed sites acceptable for industrial park development (Fig. 55).

### **Providing Adequate Level Land**

Inherent with the needs of industry for available building space is the need for level land which will simplify the building construction. Level land (not exceeding 5 per cent slope) should be the ultimate aim of a producer planning an industrial park development. An illustration of the need for level land would be a building 400 feet long on a slope falling 20 feet in that distance. In this case, added cost would be incurred in the construction (i.e., stepping or terracing the building). Terracing could, of course, be done by the industrial developer, but again at added cost. When possible, a sand and gravel site will more readily attract industry if the site improvements are a result of the extractive operations.



Irregularities on sites with potential for building areas, often have added benefits over the initially level site, in that:

1. The irregularities serve as barriers against noise, undesirable views, wind, and other nuisances.
2. The firms generally incompatible can have physical separation.
3. The separation of adjacent land uses will be possible.
4. The industrial firms can retain individual identity by being physically separated from other industry.

## Summary

Developing a site for industry will involve coordination of efforts by planning authorities associated with the community, a site planner, an industrial developer, and the owner-producer. Timing for the re-use of the site, need not wait for the total extraction. Staging operations as discussed in Chapter II with screening, can convert parts of the site for re-use. Similarly, a staged operation, for all essential purposes, will be "open" only 20 per cent or so of the total excavation time.

For the future, the simultaneous excavation and development of sand and gravel sites seems a significant, profitable venture. Depleted sites will provide a valid re-use potential for industry because of the competition for available land (Fig. 56). The producer is engaged in land conversion which, in many cases, means that he will take land of low quality, mine it, and leave land developable for industry and the benefit of the community. Thus, he performs a significant service to industry and the environment while carrying on necessary mining functions.

## REFERENCES

- <sup>1</sup> SANTA CLARA COUNTY, *Commercial Land Use Zoning*, Chapter VII, Santa Clara County Planning Department, February 1964, p. 1.
- <sup>2</sup> NATIONAL PLANNING ASSOCIATION, *Bureau of Labor Statistics*, U. S. Department of Labor, Report to the Outdoor Recreation Resources Review Commission, 1962, Washington, D. C. *Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation*, p. 23.
- <sup>3</sup> KOSTA, JOSEPH V., *Planning Residential Subdivisions*, The Appraisal Institute of Canada, Winnipeg, Manitoba, June 1954, p. 21.
- <sup>4</sup> WHYTE, WILLIAM H., *Cluster Development*, April 1964, American Conservation Association, New York, New York, p. 37.
- <sup>5</sup> COUNTY OF SANTA CLARA, *Concepts Important in Commercial Land Use and Commercial Development in Santa Clara County*, Parts I and II April 1964, Planning Department, San Jose, California, Chapters VII and VIII.
- <sup>6</sup> STANIFORD, EDWARD F., *Business Decentralization in Metropolitan Los Angeles*, Bureau of Governmental Research, June 1960, University of California, Los Angeles, California, p. 5.
- <sup>7</sup> THE COMMUNITY BUILDERS HANDBOOK, 1960 Prepared by the Community Builders' Council, Urban Land Institute, Washington, D. C., pp. 253-256.
- <sup>8</sup> IBID, p. 257.
- <sup>9</sup> URBAN LAND INSTITUTE, *The Community Builders Handbook*, 1960, Executive Edition, Urban Land Institute, Washington, D. C., p. 56.
- <sup>10</sup> TAYLOR, JAMES L., *School Sites: Selection, Development and Utilization*, 1958, U. S. Department of Health, Education and Welfare, Washington, D. C., p. 27.
- <sup>11</sup> CHAPIN, E. STUART, *Urban Land Use Planning*, 1965 Second Edition, University of Illinois Press, Urbana, Illinois, p. 446.
- <sup>12</sup> CONWAY RESEARCH, INC., "Industrial Parks; 1964," *Industrial Development*, Volume 133, (March 1964), pp. 16, 46.
- <sup>13</sup> TRI-COUNTY REGIONAL PLANNING COMMISSION, *Economic Report No. 2: Industrial Requirements*, Akron Ohio, 1960, p. 17.
- <sup>14</sup> NEW ENGLAND INDUSTRIAL CENTER, Cabot, Cabot, and Forbes, Boston, Massachusetts.
- <sup>15</sup> GRAHAM, JACK B., "Water for Industry," *American Association for the Advancement of Science*, 1956, p. 65.
- <sup>16</sup> INDUSTRIAL PARK, Houdaille Construction Materials, Inc., Kenvil, New Jersey.

**Figure 56 — A Wet Pit with Potential for Use by Industry, Residences, or Recreation**







**Figure 57(A) — An Agricultural Landscape**

## *Chapter 4*

# Summary

There is no universal pattern by which land and buildings can be joined to form an effective development just as there is no single process to encompass the diversity for developing sand and gravel sites after excavation. The possible processes are as many as there are types of sand and gravel operations and final land use types. But no matter what development patterns or excavation, there is one thing common to all: they generally involve a transition in land use from the original landscape. The nature, then, of the finished landscape depends on the quality of the development program.

It has been important in this report to emphasize new conditions or landscapes which result as one product of the excavation (Fig. 57), and examine principles which will direct the development of an optimumly suited use to the site. Although micro site conditions such as the ability of a restored landscape to support original plant materials vary, the general development requirements, the need for the wise use of our resources both surface and subsurface, and the need for supplying increasing demands for both resources places the producer in a common position: that of the "land conversion business." Demographers tell us our population will double from 1960 to the year 2000. In a sense this means that our need for natural resources to build a second America will also double. To achieve a land-

scape for a selected use, a site should be consciously shaped rather than evolving to a haphazard or all-purpose basegrade. For the long term operation, though, flexibility of operations and basegrade lends to changing land use demands.

Not only is comprehensive planning important for each site, but planning for the preservation of existing deposits and provisions for ultimate use at the regional level are also important. The responsibility for sound land practices exists not only for producers, but also for regional approaches to community design and planning. The following considerations for regional development plans are necessary:

1. A geologic survey of sand and gravel deposits to determine location, extent, and quality.
2. An inventory for the evaluation of future needs of the region.
3. The formulation of a regional master plan for the preservation of valuable deposits.
4. Master plan proposals for final landscape character and ultimate development.

A more cooperative approach for regional planning patterns must give more than a visual, esthetic dimension to subsurface resource use.



Developing a sand and gravel site cannot be done through a quick set of procedures. Largely, the objectives of development plans are designed to minimize problems and conflicts associated with early mining and later ultimate development and to foster optimum re-use of the excavated site. This development process involves consideration of the following general stages:

1. Feasibility Stage.
2. Development Stage.
3. Adaptation Stage.

Beyond establishing preliminary company policies, the *Feasibility Stage* entails important steps for the re-use of potential mineable land. Steps involving recognition of new landscape conditions, land use determinants, and esthetic relationships will lead to preliminary proposals for final site use. During the *Development Stage*, operational patterns are incorporated with revised conceptual studies and excavation begins in an organized approach to facilitate a planned basegrade. In the *Adaptation Stage*, excavation as each phase nears an end, the completed master plan can dictate finish grading for a selected use and the site can be seeded and planted to insure a more mature final development. The final development then will be the result of coordinated operations, new landscape conditions, and the master plan through graphic drawings used for implementing this complex collaboration.

Site analysis and site planning cannot progress until the purpose for which it is oriented is defined. Land use selection for a site depends on how well the site satisfies use requirements such as location, landscape conditions,

and perceptual values. Five types of land normally resulting from a sand and gravel extraction which the site analysis might recognize are:

1. Essentially level land with one or more lakes.
2. Level land readily adapted to large building sites.
3. Irregular land adaptable to large building with considerable regrading, but for a smaller building site it would require only minimal regrading.
4. Steep land adaptable with extensive regrading for small building sites.
5. Deep pits suitable for special multi-storied buildings.
6. Land for conservation measures similar to the above.

Land use of depleted sites depends upon what is physically possible, economically profitable, and institutionally and socially desirable. For the more distant site from demand and unless some feature of the site lends it to be readily developed, a development program may best be oriented to alleviate evidence of past excavations and retard erosion. For the site in the path of urban development, planning for re-use will involve coordination of efforts by planning authorities, a site planner, and a developer.

For the future, the simultaneous excavation and development of sand and gravel sites seems a significant venture. Depleted sites will provide valid potential for increasing land needs. Thus, the producer will perform significant contributions to the environment while providing the basic materials for the construction industry.



**Figure 57 (B) — A Wet Pit Landscape in an Agricultural Setting**



# Appendix

In order to discuss all conditions which exist on sand and gravel sites, there are some which are better discussed in a general application rather than referenced to a particular land use. Such items as soils common on sand and gravel sites, the character of fill areas, and knowledge of flood plain conditions are important. Information of these plus slopes, vegetation, and others which affect the selection and design of a land use will be an integral part of the analysis of the new landscape conditions resulting from operations.

## Soils

A condition in question is the capability of soils which are part of, or directly under, the existing deposit and make up the after-operations basegrade quality. As illustrated in Figure 58, soil types associated with sand and gravel deposits range from silt through sand and gravel to coarse rocks. In the second column of the table, the load-bearing capacity (weight carried before compression) varies with moisture content, and is attributed to water or air-filled voids which exist in all naturally deposited soils. As an example, very wet compacted sand, when dry, will settle under load.

If well-graded from large to small particles, rocks or gravel soils are best suited for supporting heavy building loads. In this last instance, the voids will be filled by smaller clay or silt particles that resist compaction.

Figure 58 indicates some of the relative properties of soils occurring on sand and gravel sites. Column II indicates workability or ease of handling soils; Column III indicates suitability of properly compacted soils for foundations of low buildings (maximum, three stories); and Column V indicates the desirability of various soil groups for absorption of water from sewage disposal systems. This table can be used for effectively evaluating soils that may exist on sand and gravel sites.

In some sand and gravel deposits, clay veins or other low-quality and unmineable materials may exist which will not support heavy vibratory loads. Also, serious problems can occur in areas of very fine sediments (clays, silts, and sand) which have not been compacted by glacial ice or overlying fill. If extensive, these areas

should be located accurately and then removed or compacted and used for parking or light-load purposes.

In addition to test borings for evaluating the quality and extent of deposits, a soil analysis should take into account the geological history. Also, a hydrological analysis should be taken for the effect water will have on the bearing capacity of the soil.

## Fill Areas

In addition to the normally abundant buildable land on most depleted sites, properly constructed fills can produce level basegrades, buildable land for lake developments, and sites in flood plains. Research on settlement shows that buildings can be constructed immediately after placement of well-compacted fill<sup>2</sup>. This immediate use is facilitated by acquiring a density equal to or better than that of adjacent naturally-compacted soils (Fig. 59). With increasing demand for development, fills are becoming economically more feasible.

Figure 60 illustrates the settlement of fill in different stages of compaction, and indicates that settlement of well or highly-compacted fill is negligible.

Because they soften when wet, clay and silt are generally undesirable as a fill for heavy-load areas, though proper compaction produces improved adaptation for limited use. Piles insure stability of heavy buildings, but in some instances of thoroughly compacted clay or silt, raft or wider footing-foundations can be used to reduce building costs.

For large industrial or commercial buildings having foundation loads that are static, waste and fine, loose sand encountered in some pit operations are considered adequate. Thus sand and other fine material can settle better if they are placed and compacted in layers one foot thick at a moisture content which will remain constant in the fill. Each soil has an optimum water content which favors compaction. The right amount of water acts as a lubricant to let the soil particles slide together, but is not enough to fill the voids. For this kind of information it is advisable to consult with a soil engineer for the proper compaction techniques.

For hydraulic sand fills, when the water has evapo-



	SOIL TYPE	WORKABILITY AS A CONSTRUCTION MATERIAL	COMPACTION CHARACTERISTICS	LOW BUILDINGS ON COMPACTED FILL (three story)	SEWAGE DISPOSAL AREA
GRAVEL and GRAVELLY SOILS	Well-graded gravels, gravel sand mixtures, little or no fines.	1	1	1	1
	Poorly-graded gravels or gravel-sand mixtures, little or no fines.	2	2	2	1
	Silty gravels, gravel sand-silt mixtures	2	4	3	2
	Clayey gravels, gravel sand-clay mixtures.	2	3	4	2
SANDY and SAND SOILS	Well-graded sands, gravelly sand, little or no fines.	1	1	2	1
	Poorly-graded sands or gravelly sands, little or no fines.	3	2	4	1
	Silty sand, sand-silt mixtures.	3	4	4	2
	Clayey sands, sand clay mixtures.	2	3	5	NS
CLAYS	Inorganic silts and very fine sands, silty or clayey fine sands or clayey silts with slight plasticity.	3-4	4-6	7	NS
	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.	3	4	6	NS
	Organic silts and organic silty clays of low plasticity.	4	7	8	NS
SILTS	Inorganic silts, fine sandy or silty soils, elastic silts.	4	4-8	9	NS
	Inorganic clays of high plasticity.	5	4-7	8	NS
	Organic clays of medium plasticity and organic silts.	5	8	10	NS
	Peat and other highly organic soils.	NS	NS	NS	NS

\* The numbers in each column indicate relative desirability; with "1" for groups most desirable and higher numbers for decreasing desirability. The symbol "NS" indicates a soil group "not suitable". It should be understood that the rating given is approximate and intended only as a guide for the comparison of various soil groups.

**Figure 58 — A Relative Comparison of Soil Groups Found on Sand and Gravel Sites <sup>1</sup>**



**Figure 59 — A Pasture on a Seventy-Five Foot Fill Proposed for Industry**

Type of Fill	State of the Fill	Settlement from Original Height	Settlement from Added Weight
Well-Graded Gravel	Well-Compacted	Not Available	Negligible
Sand	Well-Compacted	0.5% in two years	Very Low
Sand	Uncompacted	3.0% in three years	Low
Clay	Lightly-Compacted	1.0% in three years	Medium
Clay	Uncompacted	10.0% in four years	Very High
Mixed Refuse	Compacted	Not Available	Medium
Mixed Refuse	Uncompacted	29.0% in five years	Very High

**Figure 60 — Settlement Under Own Weight of Various Types of Fill <sup>2</sup>**



rated or drained away, manual compaction can be used to eliminate air-containing voids, thus insuring a stable fill. Sand will expand or shrink with changes in vibration from reciprocating pumps and truck movements.<sup>3</sup> Where vibration is a major threat, piles are generally used that transfer the loads to more stable underlying soil.

Desirable fill is mixtures of clay as a binder plus sand, which fills the voids, and gravels and rocks that make up the bulk of the fill. Consolidation of these materials and compaction in layers will insure adequate buildable land. Because the available fill material varies in quality, field tests should be made on a compacted portion, then the thickness of each layer of fill can be adjusted to obtain maximum density.

Using the materials normally available on sand and gravel sites, fill construction will be of three general types:

1. *Levees and embankments* for flood protection and terraces can be constructed with sand, sand with clay core, or clay placed during the dry season with a blanket of topsoil or sand. Riprap, rock fill, or plant materials can be used for erosion protection against flowing water, rain, and surface runoff.
2. *Blankets of topsoil or overburden* for minor leveling of the basegrade and for growing cover crops can be used to depths of five feet. Unlike other fills, this type should not be compacted in the top foot because the growth of plant materials can be retarded.
3. *Backfill of below-level excavations* for providing buildable land areas can be of sand, gravel, rock, clay, refuse, or any combination of these. With the consultation of a civil or structural engineer, this type can be built upon directly after filling (Fig. 61).

## Flood Protection

Planning for the re-use of sites in the floodplain is essentially the same as level land in that it involves simultaneous excavation and development of the site. Land lying in an area susceptible to flooding will naturally be less valuable for development than land above the high water mark. A site that has flood plain protection or control, however, will be well-suited for most types of development (Fig. 63). Determining usability requires knowledge of flood data for the site and of feasible on-site flood control measures. The 50-year flood data gives good indication of protection needs and can be obtained from the following sources:

1. State Water or Geodetic Survey Offices.
2. Local City or Regional Planning Agencies.
3. The State Reclamation Board.
4. The Bureau of Reclamation.
5. The U. S. Army Corps of Engineers.

Data which will help the producer evaluate the extent and need of on-site flood protection include:

1. Frequency and levels of flooding (season, 5, 10, 20, or 50-year stages and water heights).
2. Elevation of the highest flood for which records are available.
3. Duration of flood levels.
4. Rate of rise and velocity of floodwater. (This will influence the type of cover needed, such as grasses, or rock riprap for artificial control structures).
5. Maximum probable depth of the highest flood that can be expected.

Floods that reach a given height only once in fifty years are called 50-year floods and indicate that there is a probability of only one in fifty that such a flood will occur in any given year. A levee which will guard the proposed development from the 50-year flood stage offers excellent practical protection. Although dredging will occur above and below, illustrated in Figure 62, the levee is serving two purposes: as a dike to hold the lake and as a guard against seasonal flooding. Eventually, the upper terrace of the site can be developed, leaving the lower portion susceptible to seasonal floods for public recreational purposes.

The ultimate aim of the producer operating in the flood plain, therefore, should be the creation of flood protection, not only for his present excavation but for the final development. Consultation with a civil engineer for local methods of flood control is important. On-site flood controls also should be coordinated with regional studies to determine their relation to the total program for the region. In some cases, flood controls on the site may cause flooding of other areas.

Some of the general methods used against flood damage are as follows:

1. Construction of levees and dikes.
2. Providing land above the 50-year flood stage by filling.
3. Reservation of land above the 50-year stage for buildings.
4. Construction of buildings susceptible to flooding, so they will not be greatly damaged by water.
5. Construction of flood walls where space for levees is limited.



## REFERENCES

- <sup>1</sup> FEDERAL HOUSING ADMINISTRATION, *Engineering Soil Classification for Residential Developments*, November 1961, Washington, D. C., p. 35.
- <sup>2</sup> MEYERHOF, G. G., "Buildings on Fill With Special Reference to the Settlement of a Large Factory," *The Structural Engineer*, Volume 29, No. 2, pages 46-47, February 1951, and discussion, Volume 29, No. 11, pp. 297-305, November, 1951.

<sup>3</sup> IBID.





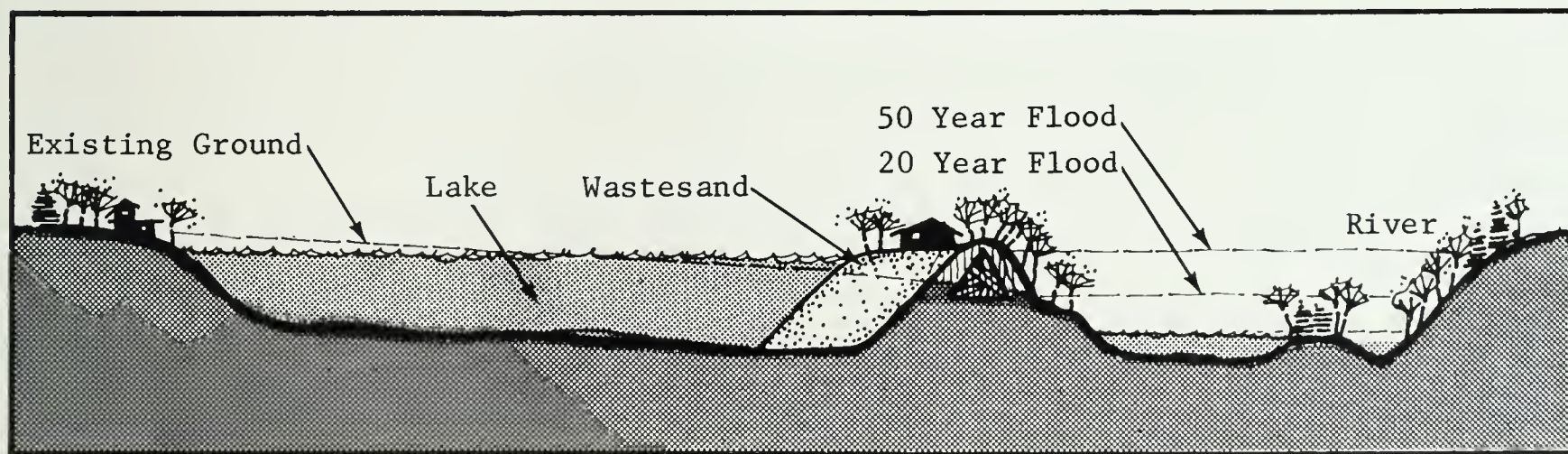
**Figure 61(A) — Excavation Filled Through Use of Settling Pond—Water Recirculates to Processing Plant**



**Figure 61(B) — Excavation Filled with Available Overburden**



**Figure 61(C) — Excavation Filled with Urban Refuse—Deposition Equals Excavation**



**Figure 62 — Use of a Levee to Provide Flood and Lake Control**



**Figure 63 — An Example of Construction Behind a Levee**



# Other References

## Land Use Selection

- BARLOWE, RALEIGH, *Land Resource Economics: The Political Economy of Rural and Urban Land Resource Use*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1958.
- CHAPIN, STUART F., *Urban Land Use Planning*, Second Edition, University of Illinois Press, Urbana, Illinois, 1965.
- CLAWSON, MARION, *Land for Americans: Trends, Prospects, and Problems*, Rand McNally and Company, Chicago, 1963.
- CLAWSON, MARION, with CHARLES L. STEWART, *Land Use Information: A Critical Survey of U. S. Statistics Including Possibilities for Greater Uniformity*, 1965, Resources for the Future, The Johns Hopkins Press, Baltimore, Maryland.
- LYNCH, KEVIN, *Site Planning*, M.I.T. Press, Cambridge, Massachusetts, 1962.
- NATIONAL ASSOCIATION OF HOME BUILDERS, *Home Builders Manual for Land Development*, Washington, D. C., 1958.
- SHELLIE, KENNETH L., and DAVID A. ROGIER, *Site Utilization and Rehabilitation of Sand and Gravel Sites*, The National Sand and Gravel Association, Silver Spring, Maryland, 1964.

## Site Development

- BAUER, ANTHONY M., *Simultaneous Excavation and Rehabilitation of Sand and Gravel Sites*, The National Sand and Gravel Association, Silver Spring, Maryland, 1965.
- CLEVELAND, H. W. S., *Landscape Architecture: As Applied to the Wants of the West*, Edited by Roy Lubove, University of Pittsburgh Press, 1965.
- DASMANN, RAYMOND F., *Environmental Conservation*, John Wiley and Sons, Inc., New York, N. Y., 1959.
- JOHNSON, CRAIG, *Practical Operating Procedures for Progressive Rehabilitation of Sand and Gravel Sites*, The National Sand and Gravel Association, Silver Spring, Maryland, 1966.
- MINISTRY OF HOUSING AND LOCAL GOVERNMENT, *New Life for Deadlands — Derelict Acres Reclaimed*, Her Majesty's Stationery Office, London, England, 1963.
- NATIONAL SAND AND GRAVEL ASSOCIATION, *Case Histories: Rehabilitation of Worked Out Sand and Gravel Deposits*, Public Relations Bul. 300, Washington, D. C., 1960.
- PARSON, RUBEN L., *Conserving American Resources*, Prentice-Hall, Inc., Second Edition, 1964.
- SIMONDS, T. O., *Landscape Architecture — The Shaping of Mass Natural Environment*, F. W. Dodge Corporation, New York, 1961.
- TUNNARD, CHRISTOPHER AND PUSHKAREV, *Man-Made America: Chaos or Control?*, Yale University Press, New Haven, Conn., 1963.

## Residential Development

- FEDERAL HOUSING ADMINISTRATION, *Engineering Soil Classification for Residential Developments*, Washington, D. C., November, 1961.
- KATZ, ROBERT D., *Design of the Housing Site, a Critique of American Practice*, Small Homes Council — Building Research Council, University of Illinois, Urbana, Illinois, 1966.
- MANDELKER, DANIEL R., *Controlling Planned Residential Developments*, American Society of Planning Officials, 1966.
- WOOD, ELIZABETH, *The Balanced Neighborhood*, Citizens' Housing and Planning Council of New York, Inc., December, 1960.

## Commercial Development

- GRUEN, VICTOR AND LARRY SMITH, *Shopping Towns USA: The Planning of Shopping Centers*, Reinhold Publishing Corporation, New York, 1960.
- HORNBECK, JAMES S., *Stores and Shopping Centers*, McGraw-Hill Inc., New York, 1962.



- METROPOLITAN PLANNING COMMISSION, *Commercial Patterns: Part II, (An extension of Economic, employment and area data, and analysis and forecast of commercial requirements in the Portland Urban area)*, Portland, Oregon, August, 1964.
- SANTA CLARA COUNTY PLANNING DEPARTMENT, *Commercial Land Needs: Problems and Policies, Part 2*, San Jose, California, November, 1964.
- STANIFORD, EDWARD F., *Business Decentralization in Metropolitan Los Angeles*, Bureau of Governmental Research, University of California, Los Angeles, 1960.
- THOMPSON, RICHARD G., *A Study of Shopping Centers*, Real Estate Research Program Institute of Business and Economic Research, University of California, Berkeley, 1961.
- URBAN LAND INSTITUTE, *The Dollars and Cents of Shopping Centers: Part One, The Entire Center*, (A Study of receipts and expenses prepared under auspices of the Shopping Center Study Committee of The Community Builders Council of Urban Land Institute), Washington, D. C., 1961.

## Institutional Development

- CHASE, WILLIAM W., *Problems in Planning Urban School Facilities*, School Plan Administration, U. S. Department of Health, Education and Welfare, Washington, D. C., No. 23, 1964.
- DEARBORN, MICHIGAN — BOARD OF EDUCATION, *Dearborn Plans the New Henry Ford Community College Campus*. The Educational Specifications, Henry Ford Community College, Dearborn, Michigan, 1959.
- DOBER, RICHARD P., *Campus Planning*, Reinhold Publishing Corporation, 1963.
- HAMMOND, SARAH LOU, *Good Schools for Young Children*, The Macmillan Company, New York, 1963.
- U. S. OFFICE OF EDUCATION, *School Sites: Selection, Development and Utilization*, Washington, D. C., 1958.

## Industrial Development

- BALDWIN, WILLIAM LEE, *Report on the Dartmouth College Conference on Industrial Parks*, Dartmouth College, 1958.
- INDUSTRIAL DEVELOPMENT, *Industrial Parks: 1966*, (A survey including listings for 1,102 industrial parks and districts throughout the U. S. and Canada), February, 1966.
- KREBS, WILLIAM A., "Trends in Industrial Parks," *Industrial Development and Manufactures Record*, June, 1959.
- QUILTY, JOSIE, "Industrial Aesthetics", *Industrial Development*, Volume 127, No. 13, November, 1958.
- THOMPSON, JAMES H., *Methods of Plant Site Selection Available to Small Manufacturing Firms*, West Virginia University, September, 1961.

## General

- AHEARN, VINCENT P., JR., *Land Use Planning and the Sand and Gravel Producer*, The National Sand and Gravel Association, Silver Spring, Md., 1964.
- AHEARN, VINCENT P., JR., AND DONALD K. CHARNEY, *Production and Value of Sand and Gravel in 1963*, The National Sand and Gravel Association, Silver Spring, Md., 1964.
- CARNES, WILLIAM G., *Sand and Serendipity*, (Speech delivered to the Annual Convention of The National Sand and Gravel Association), Los Angeles, California, February, 1967.
- HACKETT, BRIAN, The Landscape of Waste, *Landscape Architecture*, Vol. 52, No. 2, pp. 101-102, January, 1962.
- LEWIS, PHILLIP
- MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION, *Preliminary Plan for Fairland-Beltsville and Vicinity*, (A proposed amendment to the General Plan for the physical development of the Maryland-Washington Regional District), Silver Spring, Maryland, August, 1965.
- MINISTRY OF HOUSING AND LOCAL GOVERNMENT, *New Life for Dead Lands*, Her Majesty's Stationery Office, London, 1963.
- UNITED STATES DEPARTMENT OF THE INTERIOR, *Earth Manual*, Bureau of Reclamation, Washington, D. C., June, 1966.
- UNITED STATES DEPARTMENT OF THE INTERIOR, *Study of Strip and Surface Mining in Appalachia*, (An Interim Report to the Appalachian Regional Commission), Washington, D. C., June, 1966.



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